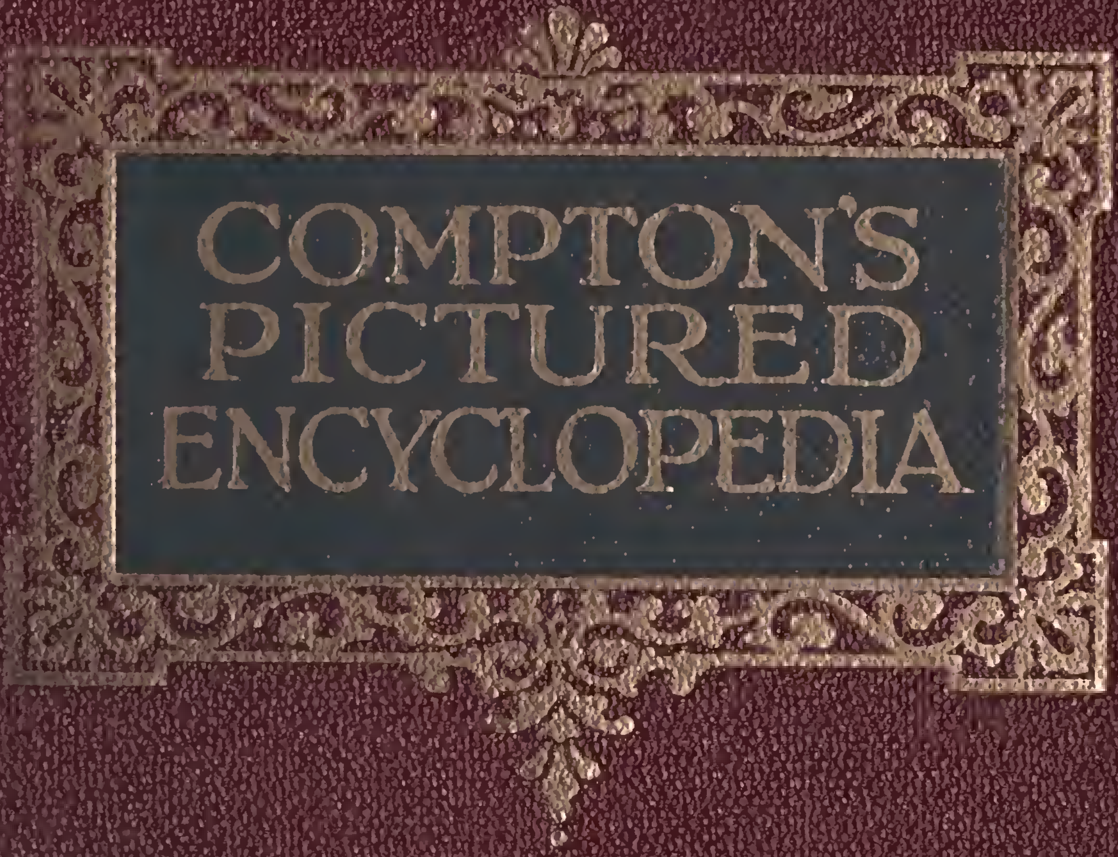

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Hilda Hanway

Faith

PESSIMISM is despair; the pessimist is the man who looks out on the world without hope, seeing gloom in everything, and believing in the worst. The world has always laughed at the dreamers who made things come true. In every age there are those who dream and those who laugh, and when the age has passed away another age comes on; and always it is true that when the world looks back it puts up statues to those who dreamed and laughs at those who laughed. . . . Let them laugh who will, but as for us, let us believe. War has its night, but Peace will have its day, and man, who has come so far, who has come from the depths and conquered all his foes, will march to victories greater yet, and make this world the very Gate of Heaven!"

(See page 1221)

FAITH

COMPTON'S PICTURED ENCYCLOPEDIA

VOLUME 3

To inspire ambition, to stimulate
the imagination, to provide the
inquiring mind with accurate
information told in an interesting
style, and thus lead into
broader fields of knowledge—
such is the purpose of this work

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HERE AND THERE in Volume Three

AT ODD TIMES when you are just looking for "something interesting to read," without any special plan in mind, this list will help you. Divided as it is into broad groups, it offers a fascinating variety of subjects for selection. With this as a guide, you may wander through storyland, visit far-away countries, meet famous people of ancient and modern times, review history's most brilliant incidents, explore the marvels of nature and science, play games—in short, find whatever suits your fancy of the moment. This list contains, however, only a small proportion of the articles in this one volume, and is not intended to serve as a table of contents, an index, or a study-guide. For these purposes consult the Fact-Index and the Study Outlines in Volume Eight.

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KEY TO PRONUNCIATION

Pronunciations have been indicated in the body of this work only for words which present special difficulties. For the pronunciation of other words, consult the Fact-Index in the last volume. Marked letters are sounded as in the following words: *cāpe, ăt, fär, fȧst, swạt, fa̤ll; mē, yĕt, fẽrn, thêre; īce, bĭt; rōw, nŏt, fôr, wȯn, do̤; cūre, bŭt, düne* (French *u*), *rṳde, fụll, bûrn; ḡo, ġem, cañyon, Jeaṅ,* (nasal); G = German *g* (guttural); K = German *ch* (guttural).

The MOST INGENIOUS *of* AMERICANS *and His Amazing Inventions*

A "born inventor" if ever there was one, Thomas Alva Edison was known as the "boy wonder of electricity" almost before he was old enough to vote. Often in early days he endangered his scant living for the pure joy of working out his ideas after he had found success and fortune the irresistible interest of his work kept him at it for long untiring hours. Five days and nights without sleep was one of his feats. It was said of him that "he kept the path to the Patent Office hot," for his patents in the United States alone numbered more than 1,000. His life may well be an inspiration to any boy who wants to attain the success of honored, useful, happy manhood.

EDISON, THOMAS ALVA (born 1847). The thing that impresses the reader of the life of Edison, first and last, is its joyousness. From babyhood he was the busiest, happiest, most interested boy in the village of Milan, Ohio, where he was born on Feb. 11, 1847. He was too busy to play much with other boys, to be sure; and at school where he spent only three months of his life, he passed for a dunce. His wise mother, however, understood her sturdy little "sober-sides," and he gained the most valuable education possible through following the promptings of his unchecked curiosity. He was a great reader, devouring Gibbon's 'Decline and Fall of the Roman Empire' and Hume's 'History of England' at an early age. Indeed, when the family moved to Port Huron, Mich., he set to work to read all the books in the public library, but he had the good sense to stop before very long.

AMERICA'S WIZARD OF INVENTIONS

Thomas Alva Edison will always be famous the world over for his many marvelous achievements in creating machines for the service of mankind. If the devices he invented were removed from the world, it would probably seem to us that civilization had slipped back fifty years.

At ten years old his favorite study was chemistry. One of his earliest experiments was to try to prepare another boy for flying by giving him a huge dose of Seidlitz powders, confidently expecting that the gases generated would make him light enough to float in the air!

At 12 young Edison had marked success as a train-boy. He sold more newspapers, books, and fruit than the other boys, and still had time to print a little newspaper and start a laboratory in one end of the smoking-car. Then one day some chemicals "blew up" and set fire to the car. The justly incensed conductor threw the laboratory and all out at the next station, and the youthful chemist after them, with a box on the ear. This unfortunately left him permanently hard of hearing—an affliction which, however, Edison often called "a blessing in disguise," since it relieved him of many distractions.

In saving the life of a station-agent's baby the lad won a friend who taught him the trade of telegraph operator. He soon became skilful in sending and taking messages, and at 15 he was in charge of an office. But he was determined to know how the instrument worked and why, and experimented with an old battery in his father's cellar until he understood it.

Edison's first invention was a telegraph repeater, by which a message is transmitted or relayed automatically to a second line which ticks it off at a slower rate. This improvement was for the purpose of enabling him to handle dispatches which came too fast for him to transcribe, but when his superiors learned of his ingenious device they rewarded him with dismissal. Then he began to experiment on the problem of sending more than one message at a time over the same wire.

The young Edison dressed shabbily and spent all he earned on books and apparatus. He was thought to be an impractical dreamy young fellow, and his employers were often impatient. For five years he led a wandering life as a "tramp operator," often out of a job, but working hard on his ideas for inventions.

At 21 Edison devised a "stock quotation" printing apparatus. For this and other inventions useful in brokers' offices he got $40,000. With this money the young genius started a laboratory and factory in Newark, N. J., for the manufacture of electrical and other apparatus. It was the most remarkable establishment in the world, where the 300 employees worked from sheer enthusiasm. Here Edison coined his inventive brains into money. He had 50 inventions at various stages at one time. But before he was 30 his health failed, and he gave up his factory for a laboratory at Menlo Park, New Jersey, where he devoted his time entirely to invention.

The Wizard's Methods of Work

A big workshop and a small house suited Edison exactly. He went about in shabby work-clothes and with acid-stained hands. Most of the time his wife and children dined alone, for the "Wizard"—as he was called—was never to be disturbed. He ate when he was hungry and rested when he was tired—working 18 and 19 hours a day as a rule—and had as much fun in his work as a boy at a ball game.

Not all of his inventions were made easily. Some he worked on for years and spent thousands of dollars in perfecting. One rule he always kept: "Be sure a thing is needed or wanted, then go ahead." The phonograph, long-distance telephone, incandescent electric light, megaphone, system of quadruplex and sextuplex telegraphy, moving pictures—these are only a few of the big inventions which owe much to Edison. The incandescent electric light made him rich, but cost him years and vast expense to perfect. Men were sent around the world to find material for the right filament. It was in 1880 that Menlo Park was first illuminated with the incandescent light. Special trains were run out for the event from New York City, and there was as much excitement as when the first steamboat made its way up the Hudson. In 1886 Menlo Park was outgrown, and an immense plant was then built at Orange, N. J.

Honors came to Edison in such numbers that he "counted his medals by the quart," as he once jokingly said. In 1915 he received the Nobel prize for physics. Wealth and fame however did not bring leisure to the inventor. His highest pleasure continued to be in his work, his deafness being another defense against outside intrusions. "One secret of his success," it was well said, "is his ability to spend years of slow and patient experiment on some seemingly trivial and uninteresting problem. There is no limit to his patience in science. Besides this it is his wonderful imagination, his unshakable optimism, and his strong self-confidence that have distinguished his work and character from that of ordinary men."

EDMONTON, ALBERTA. For a century and a quarter the name of Edmonton has been conspicuous in the annals of the Canadian Northwest. Old Fort Edmonton, an outpost of the fur trade from the beginning of the 19th century, was the crossroads at which the northern and eastern trade routes met. A few settlers took up land around the fort, spending much of their time as carriers for the Hudson's Bay Company. With their slow ox or pony carts, they would travel nearly a thousand miles to Fort Garry (now Winnipeg), carrying furs on the eastward trip and bringing back merchandise for the company.

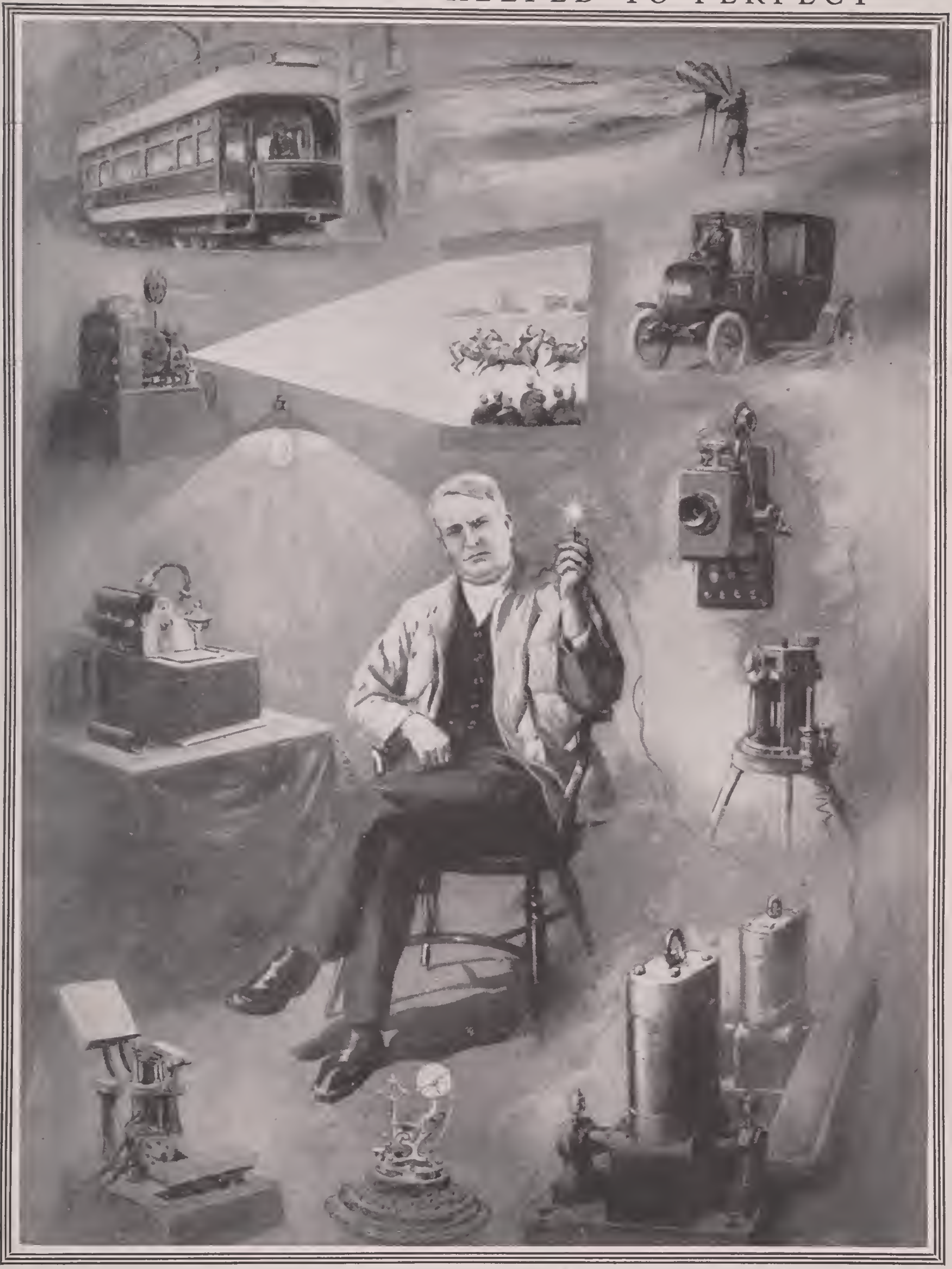
Today, as then, Edmonton is still a crossroads of trade, connected by more than a dozen railway lines and branches with the markets of the eastern and western provinces and with the great wheat-growing and cattle-raising sections of Alberta. It is still a center of the fur trade, but other industries have become of vastly greater importance. Packing houses, flour mills, saw mills, and other manufacturing plants work up the raw materials and supply their products to central and northern Alberta. Natural gas and water-power are abundant and the whole region is underlaid by great deposits of coal.

The spectacular transformation of Edmonton from a mere trading post to a metropolis has taken place almost entirely within the 20th century. In 1900 its population was little more than 2,000; by 1920 it had grown thirty-fold. As the capital of the province it has several handsome government buildings, and it is also the seat of the provincial university. The city is picturesquely situated on both banks of the Saskatchewan River, which flows through a densely wooded valley 200 feet deep and nearly a mile wide. Edmonton is also widely known for its progressiveness in municipal administration, having adopted for a time the single tax (on land only) and owning and operating its street-car service, electric light, telephones, hospitals, and waterworks. Population, about 60,000.

EDUCATION. A truly democratic country must have a public school system which gives education free to all, which covers all stages of education and permits direct passage from one grade to the next higher, and which is attended by all ranks of society. Only in modern times and in a few countries—notably in the United States, Canada, and other English-speaking countries—has this ideal been realized. Until the 19th century education was generally considered, in the broad sense, as the *privilege* of the rich and upper classes. But in the American colonies, especially among the New England Puritans and the Dutch of New York, the seeds of more democratic education were early sown. The most notable of the early school laws was that of Massachusetts in 1647, which may be said to have laid the foundations for the present free elementary and free high schools. Little by little all the states came to establish and maintain free public schools, until education has now become the right of every growing citizen. (For education in Canada, *see* Canada.)

Strange as it may seem, there were many opponents of this development, at different times and in numerous places. Not all of them were as honest as old Governor Berkeley of Virginia, who, a quarter of a century after the Massachusetts law, wrote: "I thank God there are no free schools nor printing presses, and I hope we shall not have them these hundred years; for learning has brought disobedience

DEVICES EDISON HELPED TO PERFECT



While in most cases Edison did not do all the work necessary to bring these machines into existence, his work contributed materially to all of them. Among the things his work helped to give us are the street-car and a megaphone for talking to ships at sea, on top; the motion-picture machine and the electric automobile; the phonograph and electric light, his leading personal inventions; the telephone and below it an odoroscope for measuring smells; an instrument for sending several telegraph messages at once; a machine for printing telegraph messages; and the dynamo.

and heresy and sects into the world, and printing has divulged them and libels against the best governments; God keep us from both!" The governor may be said to have had his wish, so far as free public schools in the South are concerned, for it was not until after the Civil War that such systems were generally established.

Education and the State

In time it was found that it was not enough to establish education as a *right*—it must become a *duty*. There were always parents who were not awake to the value of education for their children, or who were pressed by need to allow their sons and daughters to begin working in shops and factories before they had passed through even the elementary classes. The states began to realize that their own future welfare depended largely upon the proper training of the younger generations, and that none of its children should be allowed to suffer from neglect.

This led to the second great advance—the passage of compulsory education laws. With Massachusetts and New York again in the lead, compulsory education laws appeared in one state after another, following the Civil War, until practically the whole country was covered. These laws were followed by others regulating child labor, so that the temptation to keep children out of school to earn money was largely removed. The burden on the public schools is somewhat lightened by the existence of a great number of religious and private schools. Their plan of study does not differ materially from that of the public schools, and their pupils are regarded as fulfilling the requirements of the compulsory education laws.

Attendance at high schools has not been made compulsory, but in some states boys and girls who have completed their common school education and are employed are required to attend vocational "continuation schools" a certain number of hours a week until they reach the age of 18 (*see* School).

The work of the high schools and other secondary schools is in turn supplemented by state universities, likewise maintained at public expense (*see* Colleges and Universities).

In general, it may be said that the length of the school life of the child has gradually increased to correspond to the lengthening period of human infancy; and that, as the social and political world has become more complex, the period of education has been extended so as to increase the preparation of our future citizens.

The enormous sums devoted to public education in the United States are derived chiefly from direct school taxes; but these are further increased, in most states, by revenues derived from public lands which were granted by the Federal government for school purposes, as each state was admitted to the Union, and from other sources. These state school funds are usually apportioned by the state among the different communities in proportion to the number of children of common school age in each community. State departments of public instruction have a general supervision over the school system of the state; but in the larger cities school affairs are chiefly directed by local school boards, and also the state funds are supplemented by generous local taxes.

While the amount spent on public education in the United States is a never-ending source of wonder to Europeans, this applies mostly to city schools. The rural schools—in which more than half the children of the United States receive their schooling—have suffered from lack of adequate school buildings and adequately trained teachers, both the result of inadequate school funds. City schools are open from eight to nine months of the year, but many country schools have terms of only six months. Federal aid to the schools has been proposed to remedy this condition, on the same basis as that given by the Federal government to vocational education under the Smith-Hughes law (*see* Vocational Education).

Public libraries, free public lectures, museums of art and science, and countless other agencies help on the work of the public schools. Nowhere else in the world have such immense sums of money been given for general educational purposes by private benefactors. Great universities have been founded by single individuals, such as Cornell, at Ithaca, N.Y., by Ezra Cornell; Leland Stanford University, by the railway magnate of that name in California; and the University of Chicago, founded by John D. Rockefeller. Private and public schools and colleges are constantly receiving funds for needed buildings and laboratories, for special chairs of learning, for increasing the pay of instructors and professors, and many other purposes. In addition vast amounts have been given to found institutions of a general educational value. Examples of these are the Rockefeller Foundation in New York, devoted to the "promotion of any and all the elements of human progress," with an endowment of more than $170,000,000; the Rockefeller Institute for Medical Research, with $27,000,000; the Carnegie Foundation for the Advancement of Teaching, with funds of $29,000,000; and the Carnegie Institution of Washington, with $22,000,000, devoted to research.

School Education and Success in Life

It is of course impossible to estimate exactly the value of the education received in schools and colleges as compared to such "self education" as any ambitious person may gain from independent study and reading after the required primary school work is completed. But an interesting survey has been made on this subject, the results of which have been published by the Bureau of Education of the United States Department of the Interior. The figures, which are based upon a study of the distinguished men listed in 'Who's Who in America', are summarized as follows:

"The child with no schooling has one chance in 150,000 of performing distinguished service; with elementary education, he has four times the chance; with high school education, 87 times the chance; with college education, 800 times the chance."

The LONG LINE *of* ENGLISH EDWARDS

Their Story Covers More than a Thousand Years of History, from Edward the Elder, the Worthy Son of the Great Alfred, to Edward VII, the Genial 20th Century Sovereign

EDWARD, KINGS OF ENGLAND. Seven English sovereigns have borne the name Edward, since the Norman Conquest, and three before that event.

THE KING WHO BUILT THE GREAT ABBEY

Edward the Confessor was a good king, gentle, rosy-faced, and with white hair and beard—a most fatherly looking father of his people, although incapable of the firmness which his kingly office required. He was a man of strong religious sentiments, and one of his chief delights was in building churches. The most beautiful of these was the famous Westminster Abbey, which in its original form was built for him by Norman architects. His early years were spent in exile in Normandy, and the favor he showed to Normans paved the way for the Norman Conquest.

Of the earlier or Anglo-Saxon Edwards, EDWARD THE ELDER (ruled 899–924) was the capable son of Alfred the Great and distinguished himself by reconquering from the Danes a large part of England which at Alfred's death still remained in their hands. EDWARD THE MARTYR (ruled 975–978) belongs to the decline of Alfred's line and was murdered at his stepmother's instigation in order to bring her son Ethelred the Unready (978–1016) to the throne.

EDWARD THE CONFESSOR (ruled 1042–1066) was the son of this unhappy Ethelred and was the last of the Anglo-Saxon kings, for after his death came England's conquest by William the Norman. He was noted alike for his weakness as a ruler and his piety as a man. His greatest legacy to his people was Westminster Abbey, a building which by successive additions and rebuildings has become the "hall of fame" for the entire British nation.

EDWARD I (ruled 1272–1307) belongs to the offshoot of the Norman line which we call the Plantagenet house, and which came to the throne in the person of his great-grandfather Henry II. He was one of the greatest rulers that England ever produced. In the Barons' Wars of his father's (Henry III's) troubled reign, Prince Edward learned much both of politics and warfare. For a time he was closely associated with Earl Simon de Montfort, the popular leader of the national party. Later he opposed Simon and defeated him in the battle of Evesham (1265), in which the great earl was slain. Edward further enriched his experience by going on a Crusade to the Holy Land in 1270.

Becoming king at the age of 33, Edward accomplished three things of great importance. He united Wales and England (1284) by conquest; and from his reign dates the use of the title "Prince of Wales" for the heir to the British throne. Secondly, Edward helped on the development of Parliament and of constitutional government, by calling the "Model Parliament" of 1295, by issuing his "Confirmation of the Charters" (1297), and by distinctly recognizing the principle that no new or extraordinary taxes should be levied without the consent of Parliament. Of equal importance was his reorganization of the laws of England, which won for him the name "the English Justinian"; and by the close of his reign both the English system of law and courts and the English constitution were fully developed.

All through Edward's reign the care of his French possessions, now limited to Aquitaine, absorbed much of his attention. His chief failure grew out of his effort to unite Scotland with England—an attempt checked by Wallace at Sterling in 1297, and later defeated by the arms of Robert Bruce.

Edward I was a fine looking man, with fair hair and ruddy cheeks. He was so tall that he was nicknamed "Longshanks," but he was well knit and athletic. He delighted in tournaments, and his bravery and presence of mind were well shown in the Holy Land when an assassin tried to stab him with a poisoned dagger. He prided himself on his truthfulness, and adopted as his motto "keep faith" (*pactum serva*). All in all, he was one of the greatest of England's kings.

Edward II (ruled 1307–1327) was the unworthy son of Edward I. He had the tall stature and fine appearance of his father, but mentally and morally he was a degenerate, and was constantly under the influence of some designing favorite. He was a coward in battle, and in spite of his father's careful training had no aptitude for business. With such a man on the throne it is easy to see why the reign was one of disorder and disaster. Yet one benefit resulted, illustrating what the historian Freeman calls "the temporary evil but lasting good of a bad king." Things grew so bad that in the end Edward was forced to give up the throne, and Parliament's control over the crown was thus strengthened.

First the barons forced the king to dismiss Piers Gaveston, his earliest favorite, and when Gaveston returned they put him to death (1312). The defeat of the English forces by Bruce at Bannockburn (1314) compelled Edward to recognize the independence of Scotland. Two new favorites, Hugh le Despenser and his son, were then overthrown and put to death by the barons (1322). Five years later Edward's enemies, led by his French queen Isabella, her lover Roger Mortimer, and her brother the French king, planned a widespread revolt. They easily captured the king, with whose weakness and folly the whole land was disgusted. Then in January 1327, Parliament declared Edward II deposed and set in his place his young son Edward III. Eight months later the deposed king was brutally murdered by Mortimer.

Edward III (ruled 1327–1377) was only 15 when his father was overthrown and he himself made king. In 1330 he seized the unscrupulous Mortimer and put him to death, and sent away his unworthy mother. With this act he became the real ruler of England.

Edward III proved himself a chivalrous knight rather than a great king. He gained temporary glory but no lasting profit through prolonged fighting in Scotland and in France, where his name is associated with the first part of the Hundred Years' War (*see* Hundred Years' War). The chief results of his reign were internal. The English people became more conscious of themselves as a nation distinct from the French. There was increased use of English in the government and in the literature of the day. The war also compelled the king to summon Parliament frequently in order to secure from it money to meet his great expenses, and as a consequence it grew in importance. (*See* Parliament.) During Edward's reign a terrible plague known as the "Black Death" wiped out from one-third to one-half of the country's population, and caused great social and economic changes, whose effects lasted for centuries after the worn-out Edward III was in his grave.

Edward IV (ruled 1461–1483), the first of the Yorkist kings, grew up in the midst of the struggles between the two great houses of York and Lancaster which produced the Wars of the Roses. When he became Duke of York and leader of the Yorkist party, through the death of his father at the battle of Wakefield (1460), he was six feet three inches in height, although only 18 years old.

Edward triumphed over the Lancastrian Henry VI and secured the throne largely through the support of his powerful cousin, the Earl of Warwick, later called the "Kingmaker." But Edward soon offended Warwick by marrying against the latter's wishes, and by placing his wife's relatives in positions of influence at court. Warwick finally went over to the side of the Lancastrians; and though he for a time forced Edward to abandon England and take refuge in Holland (1470), in the end Edward proved himself more than a match for his enemies. He returned to England, defeated and killed Warwick in battle, and reëstablished himself on the throne. Immediately he caused the weak-minded Henry VI to be murdered; and some years later he also brought about the death of his own brother, the "false, fleeting, perjured" Duke of Clarence. (*See* Roses, Wars of.)

Edward showed considerable ability as a ruler and was popular till his end. He won back for the kingship much of the absolute power lost to Parliament by the Lancastrian kings who had preceded him, and did much to restore the country to a settled condition. In person and character Edward showed many of the traits which descended to his famous grandson Henry VIII. He is described as the handsomest prince in Europe, jovial and familiar with all sorts of people; but he was capable of great ferocity and was lacking altogether in moral sense.

Edward V was the son of Edward IV, and was nominally king from April to June, 1483. His cruel uncle, Richard of Gloucester, managed to get himself appointed Protector of the kingdom, and soon the little king and his young brother were shut up in the Tower of London and disappeared. There is little doubt that they were murdered by order of their uncle, who had himself crowned king as Richard III. Nearly 200 years later some bones of two children were found buried in an old chest in the Tower, and these were probably the remains of the unfortunate princes.

Edward VI (king, 1547–1553) belonged to the house of Tudor, which came to the throne on the fall of Richard III in 1485. He was the son of King Henry VIII by his third queen Jane Seymour, and became king at the age of ten years. First his mother's brother, the Duke of Somerset, and then the Duke of Northumberland controlled the government. The young king was precocious and well educated and great things were expected from him, but he died of consumption in July 1553. The Duke of Northumberland, who had married his son to Lady Jane Grey, induced Edward on his deathbed to name Lady Jane as his successor; but this intrigue failed (*see* Grey, Lady Jane). Under Edward VI the English church, which his father had merely separated from obedience to the pope, made great strides towards Protestantism.

Edward VII (ruled 1901–10) was kept from all part in the actual work of government during the long reign of his mother Queen Victoria, and was already 60 years old when he became king. He had married Princess Alexandra of Denmark in 1863, and before his accession was continually before the British public as the most active member of the English royal family, owing to his mother's retirement during her long widowhood. Edward was a man of unusual social gifts and worldly experience, and as king his course was marked by tact and judgment. As uncle to Emperor William II of Germany and to Czar Nicholas II of Russia, and as a close relative to most of the leading rulers of Europe, he was in a position to aid materially the diplomacy of his country. He was particularly effective in cementing those close relations with France and with Russia which bound all three countries in the Triple Entente against the aggressions of Germany and Austria.

In addition to his eldest son George V, who succeeded him, his surviving children were: Louise, who in 1899 married the Duke of Fife; Princess Victoria Alexandra; and Princess Maude Charlotte, who in 1896 married Prince Karl of Denmark, later King Haakon VII of Norway. Edward's only living brother was Prince Arthur, Duke of Connaught.

Eel. Farmers of the Middle Western States find occasionally in the early morning a tiny strange "snake" wriggling through the wet grass or along a muddy road. They may think it some rare poisonous reptile and kill it, but it is in reality that mysterious and much-traveled creature, the common eel. Born somewhere in the depths of the Atlantic ocean, it has voyaged to the shore, up the mouth of some great river for hundreds of miles, into a smaller stream, through the rocks and bowlders of a rushing creek, and finally out of the water and across country in search of a quiet pond, where it can rest while gaining its growth, before starting on the return journey.

The eel, which indeed looks much more like a snake than a fish, was considered a puzzle as far back as the early Greeks. The philosopher Aristotle said that eels have no sex and lay no eggs, but spring "from the entrails of the sea." It was not until 1777 that the existence of the female eel was proved. The male, which is smaller, was not identified as such until 100 years later.

Eels spend from 4 to 12 years of their life in fresh water. Then, at spawning time, they descend creeks and rivers in great numbers and put out to sea. The eggs are laid in enormous quantities somewhere in the depths of the ocean. After that the old eels die.

When the young eels are hatched they are transparent little creatures, and grow to be about three inches long in the first two months. Then suddenly they get slightly smaller, turn brown, and take on the regular eel shape—narrow head, undershot jaw, long body flattened vertically at the rear, with two fins near the throat, and a continuous narrow fin running from the middle of the back, around the end of the tail, to the middle of the stomach. As soon as the young eel has gone through this transformation, it starts to fresh water, where it begins to grow again.

WHEN THE EEL RETURNS FROM THE SEA

When the young Eels, having reached a certain stage of development, decide to quit sea life and return from the homes of their ancestors to fresh water, they make remarkable journeys overland. They often wriggle like snakes across the dewy grass to where instinct tells them fresh water is to be found.

Though they are filled with exceedingly fine bones, eels are delicious food. They are usually caught with set lines, nets, weir-traps, or eel-pots, as they travel downstream to the sea. Eels will eat almost any animal substance, dead or alive. They sometimes cause great annoyance to fishermen by devouring fish caught on lines or in gill-nets. The common eel is ordinarily between two and three feet in length, though some have been reported as long as five feet.

A form known as the "conger eel" lives only in salt water and grows sometimes six feet long, often weighing 30 to 40 pounds. This eel is common in the Mediterranean as well as in the North Atlantic. It is not eaten in the United States as much as it is in Europe, where it is considered a great delicacy. All eels are believed to grow very old, ancient Roman records showing that one, probably of the conger variety, was kept in captivity 60 years.

The so-called "electric eel" of Brazil (which is not a true eel but a low form of fish) is capable of deliver-ing an electric shock strong enough to stun a man (*see* Torpedo-Fish).

Scientific name of common eel, *Anguilla chrysypa;* of conger eel, *Leptocephalus conger.*

EGG. Almost all animals begin life in the egg, except the very lowest single-celled creatures, which reproduce by simply splitting in two. Among the higher animals such as the mammals, however, the egg usually develops and "hatches" inside the body of the parent, and the young is born alive. For this reason they are called "viviparous," from the Latin words meaning "to produce alive." But among birds, and most reptiles, fishes, insects, etc., the egg is laid by the mother to be hatched later. They are called "oviparous," meaning egg-producing. Such eggs have always a protective covering containing the life germ of the young and a supply of food—the yolk—to nourish it until hatching time (*see* Embryology).

In general, the dangers to which the eggs and young are exposed determine the number of eggs that must be laid by any animal, if its race is to survive. Thus the auks, which nest in inaccessible places, lay only one egg each season (*see* Birds), while certain fishes, like the sturgeon and the turbot, whose eggs are easy prey for hundreds of enemies, lay millions at a time. The oyster is one of the most prolific of all creatures, a very large oyster producing each year about 60,000,000 eggs. Birds' eggs, and those of crocodiles and certain turtles, are provided with a rigid shell. But most of the reptiles have eggs covered with a tough elastic membrane, like parchment. The eggs of fish, toads, frogs, salamanders, etc., are usually surrounded by a jelly-like substance, which often binds them together in great masses. Those of certain sharks are contained in strange horny flexible cases, while those of the octopus are produced in clusters, like berries attached to a stalk. Certain snails lay eggs as large as a pigeon's, and some of the slugs produce eggs with a covering so elastic that they will bound like a rubber ball. The egg-cases of many marine snails are very strange and wonderful.

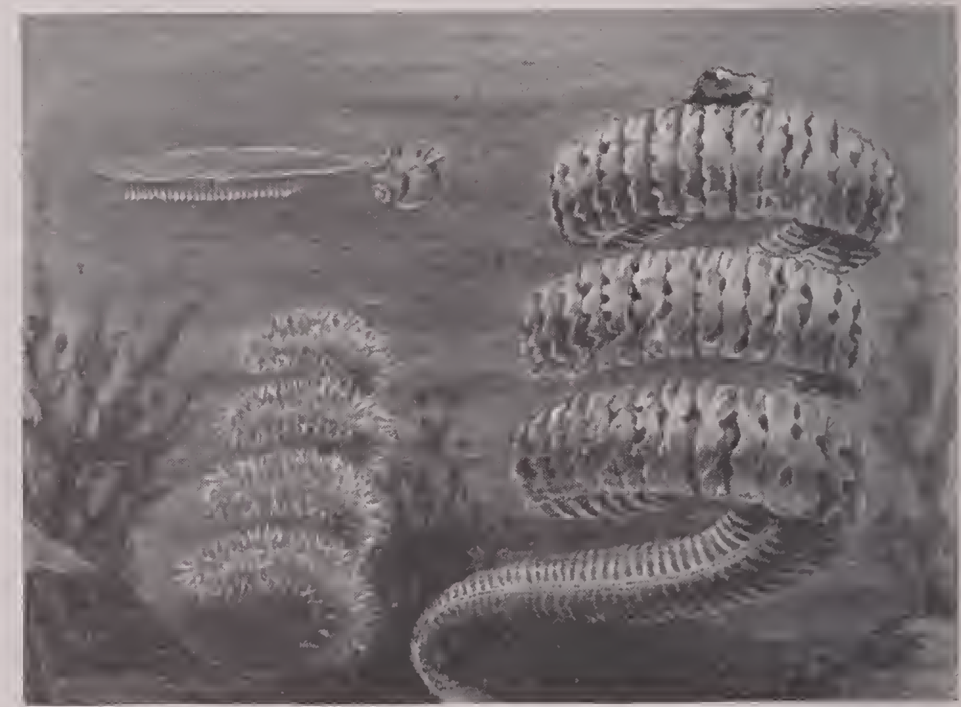
The only egg-laying mammals are the duckbill and the spiny ant-eater (*see* Duckbill). The members of other orders of animals vary greatly in this respect. Some snakes bring forth living young, others lay eggs. This is also true of lizards and fish.

Reptiles, as a rule, leave their eggs to be hatched by the warmth of the ground, but some species of boas jealously guard them, inclosing them in the coils of their bodies. The stickleback is one of the few fish that build nests and hatch their eggs.

Australia, which produces the duckbill with its queer egg-laying habits, produces also a group of birds which hatch their eggs like reptiles. They are called the *Megapodes*, and are the only birds which do not "brood" or incubate their eggs. The brush turkey of East Australia, for instance, simply scratches up mounds of earth and leaves, lays its eggs in the mound and waits for the heat generated by the sun and by the decaying vegetation to hatch them. The mallee-bird of western Australia, a near relative of the brush turkey, has much the same habit.

The egg-laying habits of insects present, perhaps, the greatest variety of safeguards employed for their protection. Some, like the bees and wasps, place them in specially constructed combs or cells; others, like the ichneumon flies, plant them in the bodies of other insects, or, like the gall-flies, imbed them in plant tissues. Mosquitoes lay their eggs in little rafts on the surface of water, and buffalo gnats glue theirs to submerged rocks. But the list of peculiarities is too long to relate in full (*see* Insects).

THE SNAIL'S EGG BASKETS

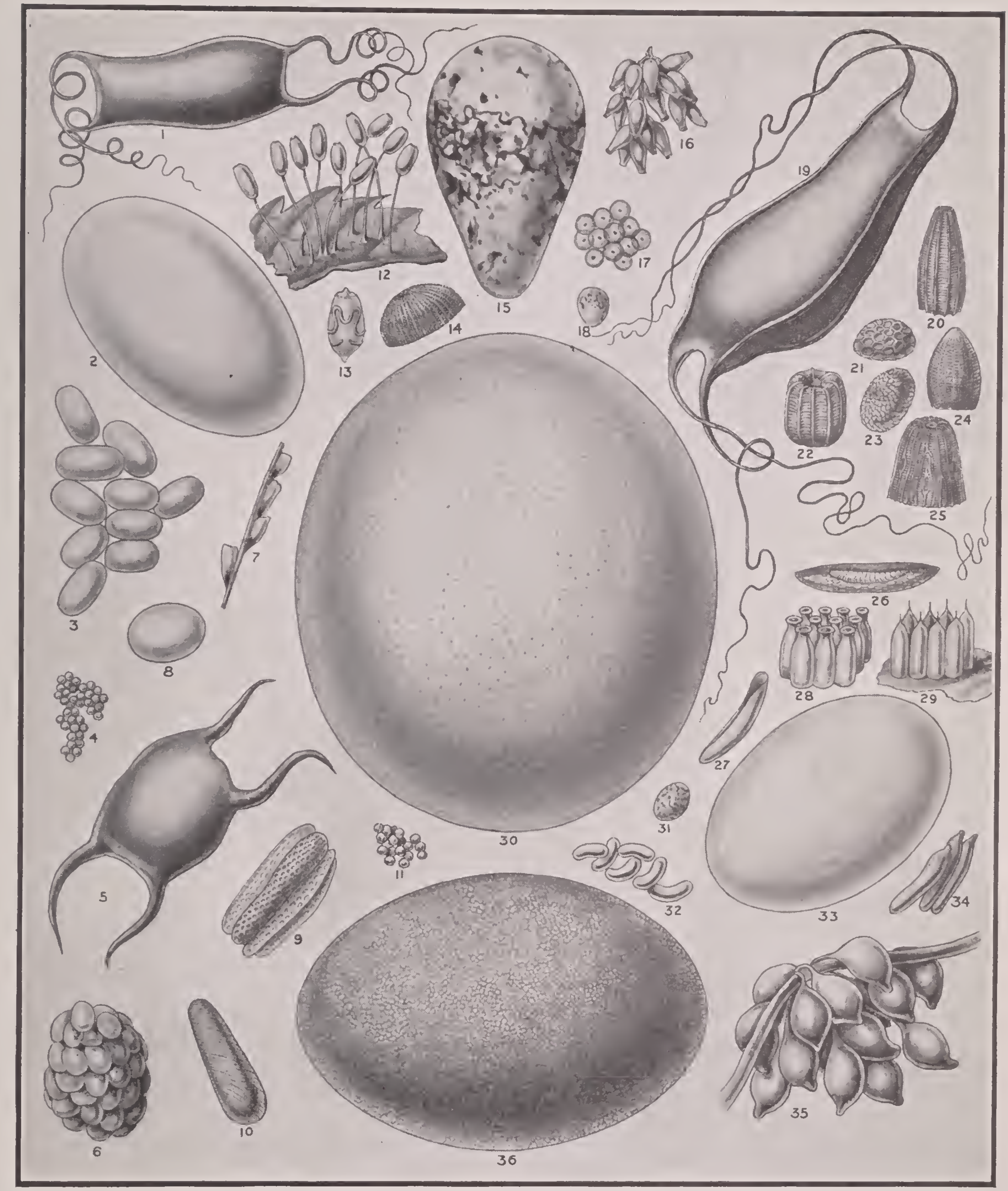


Whatever else you might take these pictures for, you would never think they were egg baskets, would you, but they are—the egg baskets of snails; and like so many other things in nature they are marvels of beautiful design. The coiled figure on the right is that of the Fusus Snail. It is first an egg basket and then a nursery, for the eggs hatch out right in the basket. Next, to the left, is the thorny coil of another species. Above it is a kind of raft made by the violet shell snail for the baby snails to ride on. Curiously enough, however, they ride not on the top, but on the bottom of the raft, as you can see for yourself. Nearest to the mother snail are eggs which have been recently laid. Next to these are young snails with fully developed shells, while the shells at the further end are broken and empty; for these little snails are the first born of the family and have already struck out into the world, the great world of the salt sea in which they live.

Spiders usually safeguard their eggs by surrounding them with tiny silky bags, which may be suspended in some protected place or carried around by the mother until hatching time (*see* Spiders).

Many varieties of eggs are eaten besides hen's eggs. In many countries the eggs of ducks, geese, and guinea fowls are looked upon as delicacies. In most tropical countries, turtle eggs form part of the diet of the shore-dwelling natives. Fish eggs, under the name of "roe," or salted and prepared as "caviar," are recognized delicacies the world over.

NATURE'S FANCIES IN THE WORLD OF EGGS



In the world of the grocer there are only three kinds of eggs, "fresh," "strictly fresh," and plain eggs. And since these are all hen's eggs, they are all of the same shape; but in the wide world outside the grocery what a wonderful variety in design! Some are oval; some have points and even tendrils; some are single, others come in clusters and still others are set up on stalks. This group of pictures shows a few distinctive types: Dog Fish (1), Crocodile (2), Grass Snake (3), Salmon (4), Skate (5), Whelk (6), Head Louse (7), Duckbill (8), House Fly (9), Flesh Fly (10), Snail (11), Lace-Wing Fly (12), Walking Stick (13), Cotton Worm Moth (14), Guillemot (sea bird) (15), Purpura (shell-fish of which crimson dye is sometimes made) (16), Frog (17), Creeper (bird) (18), Shark (19), White Butterfly (20), Copper Butterfly (21), Tortoise Shell Butterfly (22), Blue Butterfly (23), Milkweed Butterfly (24), Queen of Spain Butterfly (25), Malaria Mosquito (26), Stable Fly (27), Wheel Bug (28), Alder Fly (29), Ostrich (30), Grasshopper (31), Leaf-Cutter Bee (32), Python (33), Snake Fly (34), Cuttlefish (35), Emu (36). You must remember also that in addition to the great variety in appearance which the pictures show, there is also a much greater difference in size between many of the eggs than appears in the picture. The ostrich egg in the middle, for instance, is about six inches long and weighs nearly three pounds, while most of the insect eggs are no bigger than a pencil point.

The KINGDOM *of* FATHER NILE

Extent.—675 miles from north to south, 500 miles from east to west. Area of Egypt, about 350,000 square miles; population, about 13,000,000. Area of Anglo-Egyptian Sudan, about 1,000,000 square miles; population, about 3,400,000.

Physical Features.—The Nile, 4,000 miles long, longest river in the world except the Missouri-Mississippi; the fertile Nile valley, varying from 2 miles or less to 120 miles in width; deserts and oases; the Fayum; the delta of the Nile.

Engineering Features.—Suez Canal, 100 miles long, across Isthmus of Suez; Assuan Dam, 1¼ miles long, 147 feet high; "barrages" at Esna, Assiut, Zifta. Railroads in Egypt, more than 3,000 miles; in Anglo-Egyptian Sudan, 1,500 miles.

Chief Cities.—Cairo (800,000 population), Alexandria (445,000), Port Said (91,000), Tanta (75,000), Assiut, Suez, Damietta; Khartum.

Products.—From Fayum and lower Egypt, cotton, rice, Indian corn, wheat, barley, clover; from upper Egypt, cereals and vegetables.

History.—Rise of Egyptian civilization between 5000 and 4000 B.C.; the Pyramid Age, 3000-2500 B.C.; Egypt's wide empire, 1580–1150 B.C.; Age of the Ptolemies (Greek rulers), 323–30 B.C., followed by Roman rule; since 641 A.D., Mohammedan; British occupation begun in 1882; tribute to Turkey ended in 1914.

EGYPT. "A country which is not a country but a longish strip of market garden"—this is Kipling's description of Egypt. Out of a total area of about 350,000 square miles, only 12,000 square miles, an area less than that of Ireland, can be used for permanent habitation. This is chiefly in the Nile valley, a narrow strip of country hemmed in by the Arabian hills on the east and the Libyan Mountains on the west and varying in width from 2 to 120 miles. This fertile valley, in outline like the sacred lotus flower with the delta for the blossom, is a gift of the river. Without the Nile, which for centuries has deposited a thin coating of rich mud upon the sand, Egypt would not be different from the rest of the Sahara desert.

A Fertile Land where Rain Seldom Falls

The brilliant sun that shines out of a deep-blue sky, turning everything to colors so vivid as to make your eyes ache, is a desert sun, piercing the driest air in the world. Under its glare the fields and palm trees along the reddish brown or dull green river appear the greenest things in the world, the sand pours over the bare yellow rocks in a torrent of gold, and the rocks cast purple shadows. In Upper Egypt you will meet people who have never seen rain. At Cairo, 100 miles from the sea, there are four or five showers a year, and even on the Mediterranean coast there is only one-fifth as much rain as you will find in the driest part of England. And yet the Nile valley is everywhere productive, and the dwellers on the lower Nile count their harvests in terms of three crops a year.

The Nile valley is not only a garden. It is a museum where one sees gathered the works of the oldest civilization and of the most recent. Before Abraham was, before Moses, before Ur of the Chaldees, before Christ or Caesar, Egypt was the seat of a civilization, mature and rich.

You may travel today quite luxuriously by sleeping car and river steamer from the mouth of the Nile to Gondokoro near its source. Along the banks you will see the best of modern irrigation works and you will still see the slender brown-skinned *fellahin* ("plowers") irrigating their land by means of the *shadoof*, a primitive well-sweep. For 100 days in the summer they must swing their leather buckets into the Nile day and night, and thence by three lifts get the water up the bank to their fields.

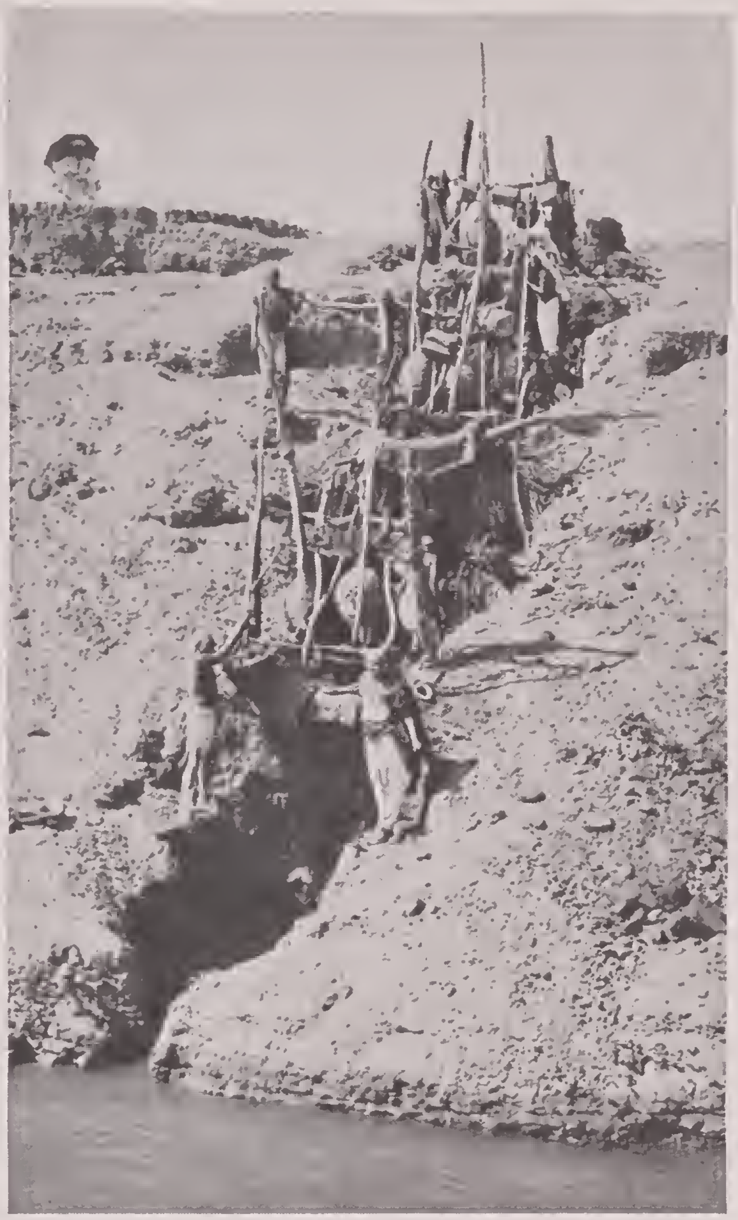
Along the banks of the Nile you will find the oldest monuments in the world, among them great temples, the Pyramids, and the Sphinx. You will also find there some of the greatest works of modern masonry, the Nile dams and "barrages."

Beyond the hills that sometimes come down to the very bank, leaving but a hand-breadth of level land, lies the desert. The hilly Arabian desert on the east (not to be confused with the desert of the same name in Asia) rises in a series of steplike plateaus to lofty mountains bordering the Red Sea. Here dwell scattered groups of nomad Bedouins, and here are the remains of mines from which the ancient Egyptians drew their wealth of gold. Here and there are dry river beds known as *wadis*. In the rare thunderstorms these carry torrents which cast bowlders about like pebbles. The wind sweeps over the desert so mercilessly that not even sand is left upon much of its rocky surface. In some districts of the Libyan desert, however, to the west of the Nile, are immense crescent-shaped sand dunes that creep onwards about 50 feet a year burying everything in their path. The Bedouin fears these "dust devils," though he knows so well how to protect himself by wrapping his head in his blanket and crouching in the lee of his camel. In the Libyan desert are five large oases made fertile by abundant supplies of underground water which rises to the surface in springs or through deep wells. Kharga, the southernmost, is reached by a railway and supports a population of 8,000 upon crops of dates, rice, and cereals.

The Fayum, one of the most fertile provinces of modern Egypt, also lies beyond the valley wall to the west. It is just south of Cairo and separated from the Nile valley by six miles of desert. The Fayum occupies a depression in the Libyan desert into which the engineers of the Pharaohs 4,000 years ago drew off the waters of the Nile in years of great flood. The Fayum today is a land of flowing streams, and abounds in oranges, peaches, pomegranates, olives, figs, and grapes, besides cotton, sugar, and the cereal crops, and is famous for its roses.

The region thus far described is chiefly Lower Egypt and the territory near it. Let us now survey the Nile country from the Sudan to Cairo coming north down the river.

ANCIENT "SHADOOFS" AND THE THIRSTY FIELDS



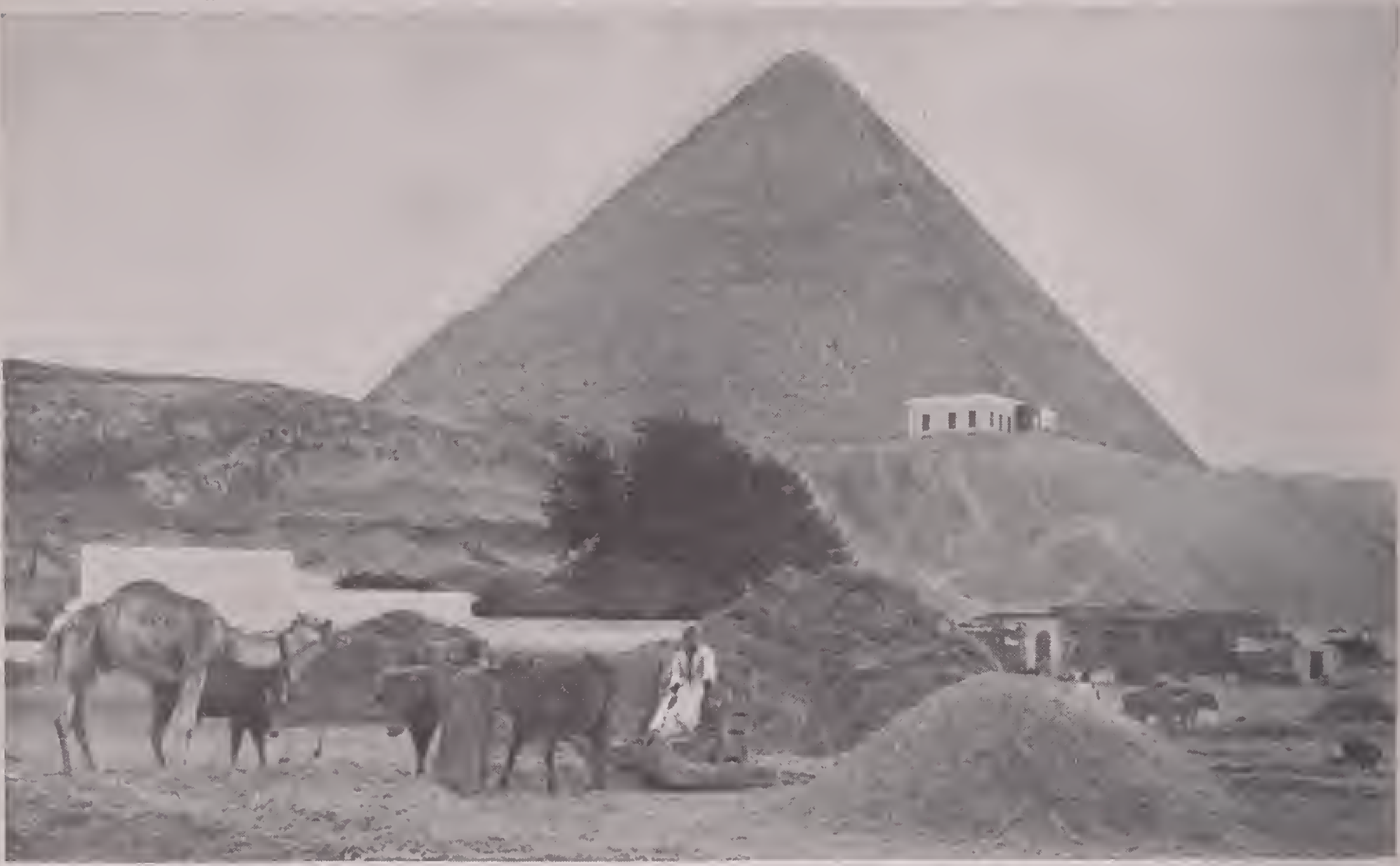
This picture shows a primitive method of irrigation still in use in Egypt, by which Father Nile is made to climb the stairs, so to speak, and water the thirsty fields. It consists of a group of shadoofs, which are devices much like well-sweeps, with a leather bucket at the long end and a weight at the other. Each group lifts the water one stage, until it reaches the top, where it is emptied into the irrigation ditches.

These are Egyptian water carriers filling their leather bottles from the waters of the Nile. Then they go up and down the village streets selling water for drinking and cooking.

From Lake Albert to Wady Halfa, a distance of more than 1,600 miles, we pass through the Anglo-Egyptian Sudan—a vast region of more than 1,000,000 square miles, with a population of 3,400,000, conquered between 1896 and 1899 by the joint resources of the Egyptian Khedive and Great Britain. The word Sudan means "black man's country," and the Anglo-Egyptian part of this great belt across Africa is the chief source of the world's supply of gum arabic and ivory. It produces also cotton, ostrich feathers, dom palm nuts (a sort of vegetable ivory used for buttons), dates, sesame, hides, skins, gold, and in the southern districts, rubber. The forests along the White Nile contain valuable trees, ebony, gum acacia, bamboo, and rubber creeper.

At Khartum, the scene of "Chinese" Gordon's death and of Kitchener's triumph, the White Nile meets the Blue Nile from Abyssinia. Across the river from Khartum is Omdurman (population, 85,000), the trading headquarters of the Anglo-Egyptian Sudan. North of Khartum is a dusty region where grow only thorny acacias. It is said that these are relished by the goat and the camel, "the goat because of his optimism and the camel because of his pessimism." Through Nubia the hills come down to the river's edge with only a fringe of land sometimes narrow

FARMING IN THE SHADOW OF THE PYRAMIDS



Do you remember how Joseph and his brethren went down into the land of Egypt to get "corn"—that is, what we call "wheat"? Undoubtedly the "corn" they put into their sacks to take back home was threshed in much the same way as this heap of wheat has been threshed out in the shadow of the Great Pyramid at Gizeh. The wheat is laid on the ground in a circle, and then the oxen, hauling a heavy sledge, tramp round and round, and so crush out the grain, which is winnowed by being repeatedly tossed up into the air.

enough to jump across, sometimes spreading out like a bay in the hills with clusters of palm trees.

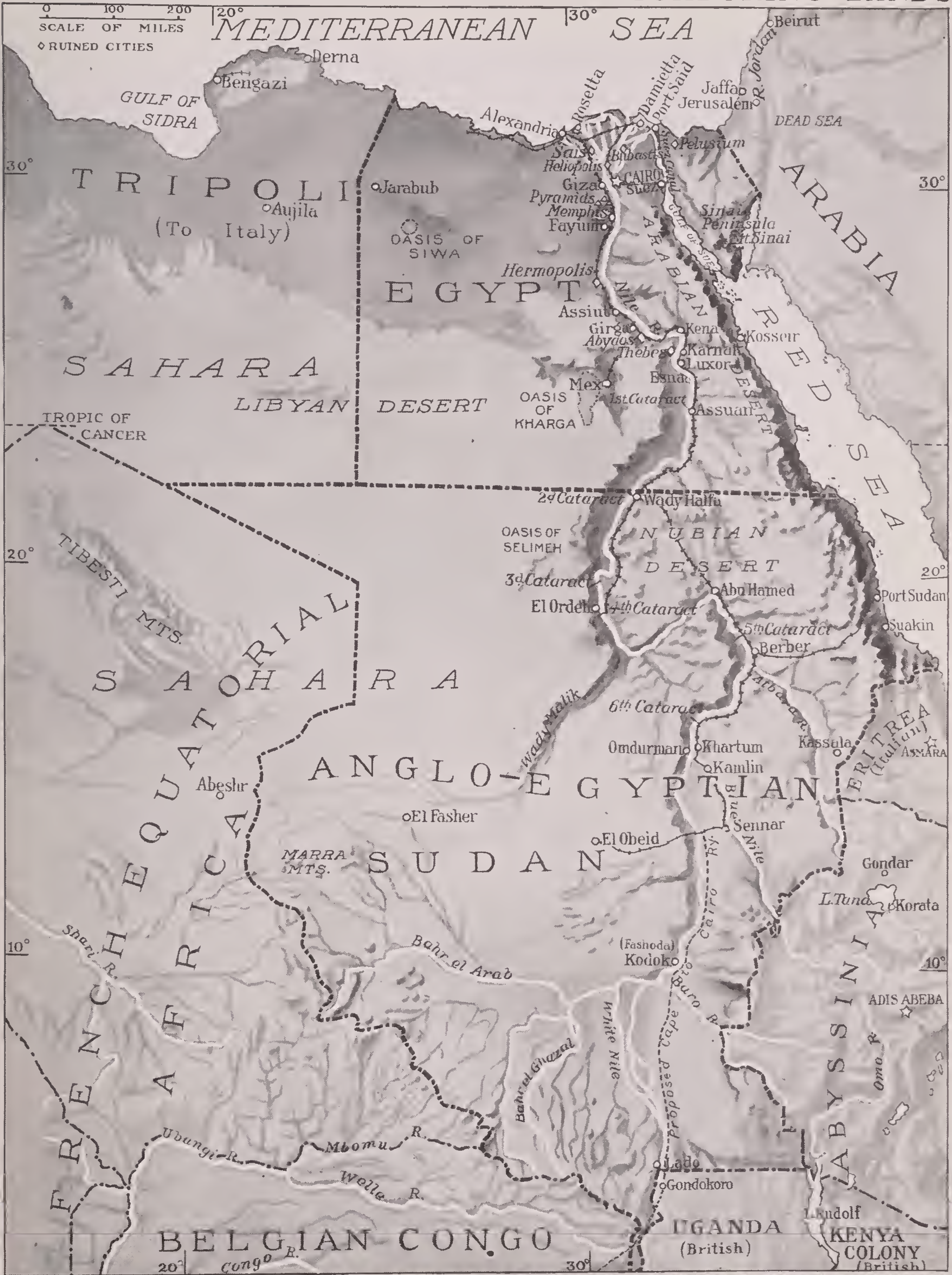
From Wady Halfa, the southern limit of Egypt proper, to Assuan is a two nights' river journey downstream, which will seem very delightful after the hot 24 hours in the train from Khartum. If you happen to be making it in February you will begin to notice strange things some time before you reach Assuan. The river widens into a lake a mile wide with rocky islands showing here and there—the tops of the temple of Philae visible on one of them—and palm trees are growing straight out of the water. This is the result of the great dam that has been built at Assuan, the first cataract, for the purpose of storing the Nile waters in flood time for use later on in the drought. The dam is a mile and a quarter long, higher than most church steeples, and rivals most of the world's masonry works—even the Pyramids themselves.

At Assuan the real Nile valley begins. Limestone cliffs rising in places to 1,000 feet from the valley floor and forming a wide canyon for the river begin to open out, sometimes leaving a few yards of bank on either side of the river, sometimes 30 miles of it. A field of waving sugar cane, very green, a cluster of palms surrounding a village, a stretch of sandbanks very golden and then a glowing wall of rock—this is the scenery of upper Egypt, and its crops are onions and sugar, food and fodder. In the early summer you can smell for a long distance the onion trains on their way to Alexandria. In Upper Egypt there is usually the yearly flood crop, and any small gardening that is done in the summer must be provided with water lifted by hand or by the buffalo wheel.

At Esna is the first of the Nile barrages, a masonry structure which piles the water up, not to dam it completely but to force it through the irrigation canals and ditches and onto the fields along the riverside. Just beyond, the cliffs open out to form a wide double bay, the plain of Thebes. Here you will see temples and cliff tombs rising out of the green crops, and in the distance the Colossi of Memnon. In this region the manufacture of antiques to sell the gullible tourist is almost as much an industry as agriculture.

From Girga to Assiut is the Coptic center of Egypt. Here are the two great Coptic monasteries, the White and the Red, founded in Roman times. The Copts, whose name is just a corruption of the Greek "Aegyptioi," are racially the same as the other people of Egypt. They are, however, of purer descent, since they refused to intermarry with the Arab conquerors, and their language—although in disuse since the 16th century except for ritual—is descended from the ancient Egyptian. Their church is one of the earliest forms of Christianity. They have never yielded to

THE HISTORIC NILE VALLEY AND NEIGHBORING LANDS



When we say "Egypt" we usually have in mind only the "longish strip of market garden" that borders the Nile as far as the Second Cataract, though the boundaries of Egypt include an area 30 times that of the Nile valley. Note the proposed railway line across the Anglo-Egyptian Sudan which will unite the Cape of Good Hope to the Nile delta.

WHEN THE SPOUTING GATES ARE OPENED AT ASSUAN

Since we see that all the gates of the great Assuan Dam on the Nile are open, we know that this picture must have been taken some time between the first of March and the middle of November. You see, it is like this: When the river is at the highest flood, it brings down so much soil that, if the waters were stopped by the dam, the deposit would soon fill it up. After the middle of November, however, the waters are comparatively free from deposit. So at that time they close the gates and catch the clear water. Then in March they open them again and let Father Nile with his load of mud go on about his business.

Mohammedanism. The Copts, although less than one-fourteenth of the population, furnish a large proportion of the clerical and skilled labor of Egypt.

The Vivid Green of the Delta

As you approach Cairo the eastern cliffs turn sharply away to the east and the low hills of the Pyramid plateau—opposite Cairo—drop out of sight. You are suddenly in Lower Egypt or the delta of the Nile. This last hundred miles before you reach the Mediterranean is watered by 300 miles of the Nile, which here flows in two main branches emptying into the sea at Rosetta on the west and Damietta on the east. Here you will see little villages of dark mud-brick huts and groves of graceful date palms. The landscape is carpeted with vivid green, and crossed by such a network of irrigation canals that in summer little water is left to reach the Mediterranean through the natural channel of the Nile. All the larger cities of Egypt—Cairo, Alexandria, Port Said, and Tanta—are in the delta.

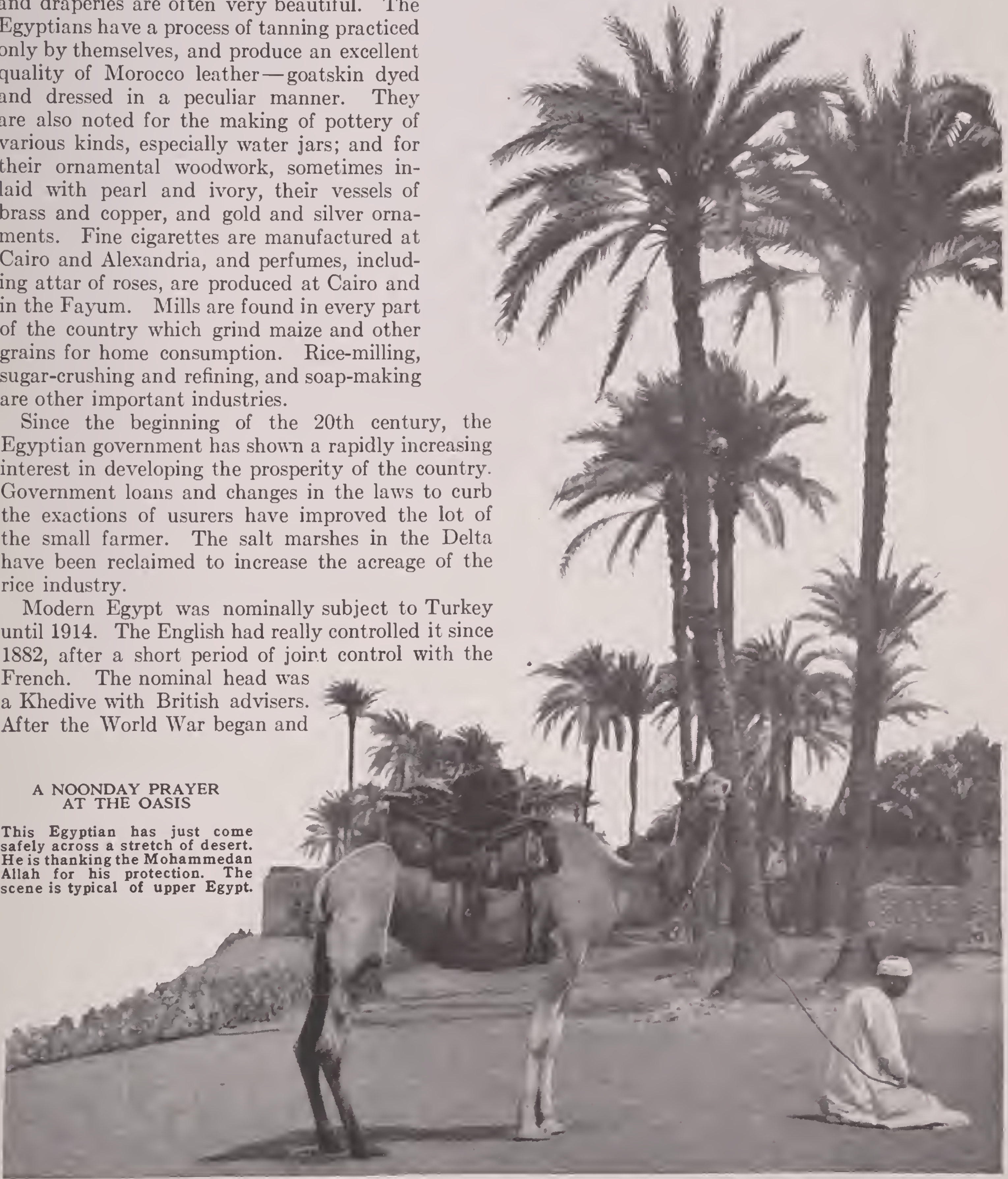
More than 60 per cent of the 13,000,000 inhabitants of Egypt as a whole are agricultural laborers (*fellahin*). The Egyptian government is the ultimate proprietor of the land, getting a large proportion of its revenue from the land tax. Nearly 60 per cent of the land under cultivation is in holdings of 50 acres or less, and more than 60 per cent of the landowners get their entire living from an acre or less of land. This is made possible by the fact that perennial irrigation is practiced on something more than two-thirds of the 6,000,000 cultivated acres, and thus two or three crops are obtained every year. Where the basin system of irrigation is practiced (that is, flooding at time of high Nile) only one crop can be harvested. Cereals of all kinds are sown in November and harvested in May and June. The chief crop is cotton, which is remarkable for its excellent quality. In Egypt the cotton plant yields five and sometimes six crops before replanting is necessary. The value of the crop is in some years nearly $200,000,000. Wheat, corn, rice, barley, and vegetables are also extensively cultivated.

The fellahin live in close-packed villages. They do not waste their precious land for house-building, and besides they like the outer gates that can be closed at night against marauding brigands. To most of us their lives would seem to be very miserable, for not only do they work hard and live wretchedly, but they are especially afflicted by the plagues that more or less trouble everyone in Egypt—flies, fleas, and eye diseases. They seem to have become almost immune to sunstroke and so accustomed are they to their own discomforts with insects that when a pest afflicts their cotton or their animals they usually do not do anything about it until the government makes some regulation forcing them to. The wealth which their land is bringing them under scientific irrigation, and the introduction of schools is gradually making their lot less miserable.

Few manufactures are carried on in Egypt, which is essentially an agricultural country; but the immense quantity of cotton that is raised gives rise to numerous mills where it is ginned and the seeds are crushed for their oil. Calico and other coarse cotton cloths are made, and Egyptian hand-woven silk shawls and draperies are often very beautiful. The Egyptians have a process of tanning practiced only by themselves, and produce an excellent quality of Morocco leather—goatskin dyed and dressed in a peculiar manner. They are also noted for the making of pottery of various kinds, especially water jars; and for their ornamental woodwork, sometimes inlaid with pearl and ivory, their vessels of brass and copper, and gold and silver ornaments. Fine cigarettes are manufactured at Cairo and Alexandria, and perfumes, including attar of roses, are produced at Cairo and in the Fayum. Mills are found in every part of the country which grind maize and other grains for home consumption. Rice-milling, sugar-crushing and refining, and soap-making are other important industries.

Since the beginning of the 20th century, the Egyptian government has shown a rapidly increasing interest in developing the prosperity of the country. Government loans and changes in the laws to curb the exactions of usurers have improved the lot of the small farmer. The salt marshes in the Delta have been reclaimed to increase the acreage of the rice industry.

Modern Egypt was nominally subject to Turkey until 1914. The English had really controlled it since 1882, after a short period of joint control with the French. The nominal head was a Khedive with British advisers. After the World War began and Turkey joined Germany, the British took over Egypt for what it really was, a British protectorate under its own sultan. It is a vital part because of the Suez Canal and the route through the Mediterranean to India. There has been considerable unrest among Egyptians, whose educated classes are stirred by the spirit of nationality, and increasing rights of self-government are the result.



A NOONDAY PRAYER AT THE OASIS

This Egyptian has just come safely across a stretch of desert. He is thanking the Mohammedan Allah for his protection. The scene is typical of upper Egypt.

EGYPT'S ANCIENT TOMBS *and* MONUMENTS

AND now let us take a steamer at Cairo and voyage up the Nile to read the story, going back 6,000 or 7,000 years, that its tombs and monuments have to tell. Nowhere else in the world can we find so complete a history of man's progress for so long a time, and nowhere else can we trace so fully the links in the chain which led him up from barbarism.

The Nile valley was the chief cradle of the earliest civilization, in the days when men first learned to erect buildings more permanent than mud-daubed huts and to fashion metals and make written records. The hot drifting sands and rainless atmosphere of Egypt have also preserved the remains of that civilization in greater abundance than those of any other early people. In burial pits of the late Stone Age, scooped out in gravel beds below the sand, we find the bones of Egyptian peasants and chiefs who died more than 6,000—some scholars think 10,000—years ago. By their side lie stone implements and pottery, which tell us that though they had not learned the use of metals, they were skilled at molding and baking clay into jars to hold food and drink. Picture records show local chieftains controlling the irrigation ditches and collecting taxes of grain and flax. Fragments of linen, small stores of barley and spelt wheat, vase-paintings of boats with oars and sails, give us further glimpses into the life of those old Nile dwellers in that far-off time. (*See* Stone Age.)

The Earliest Dawn of History

Stop for a moment to think how ancient these records are. Think back 2,000 years to the shadowy figure of Queen Cleopatra, last of the ancient rulers of Egypt. How long ago that seems! But go back another 2,000 years before Cleopatra, and Egypt was already an ancient empire with 1,400 years of known history! No wonder an Egyptian priest said to the Greek historian Herodotus, about 450 years before Christ, "You Greeks are only children!"

Go back to about 4000 B.C. and we reach the time when some unknown Egyptian discovered strange metallic beads melted from the copper-bearing rocks with which he had banked his camp-fire, and so learned the use of metals. Go back another thousand years—to about 5000 B.C.—and we find these mysterious people of the dawn of history already irrigating their fields of flax and wheat, weaving beautiful stuffs of linen, and making pottery; though their only tools were of stone and bone and their only houses were wattled mud huts.

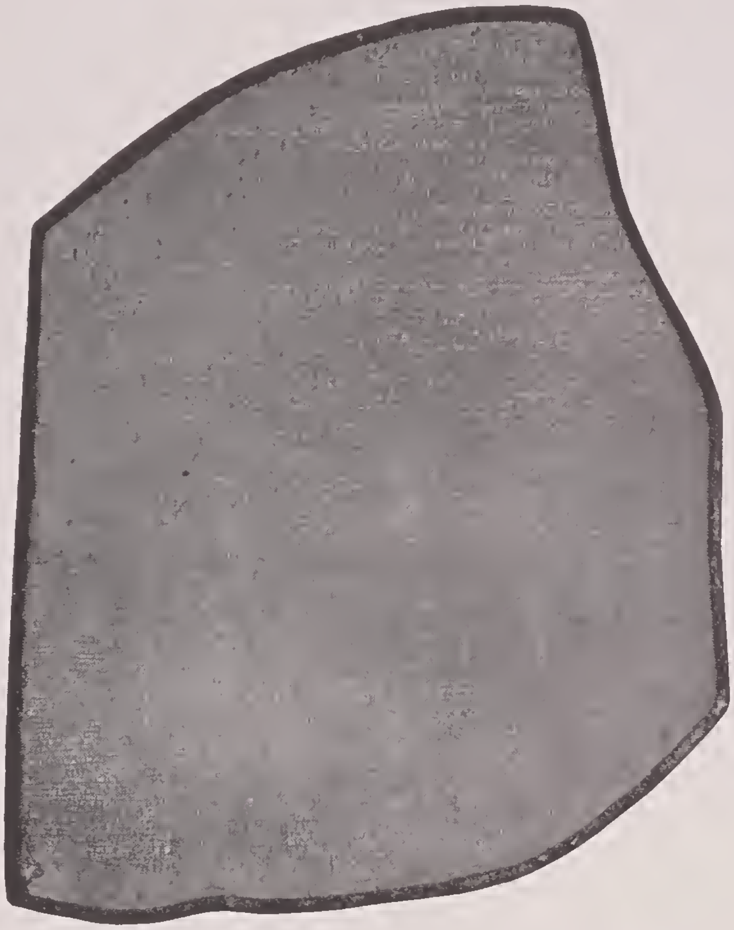
Only a generation ago this fascinating chapter of the world's oldest history was unknown. It is only within the last few years that the men of science we call archeologists have discovered it, and read its pages by delving in the sands and uncovering the burial pits of four, five, and six thousand years ago.

Tombs of later dates continue the story. They show us how the ancient Egyptians learned to make paper from the papyrus plant, how they developed their early picture writing into alphabetic writing (*see* Writing), how they learned to mold bricks, cut stone, and carve statues. And not only do we find their paintings, their pottery, their jewels, their tools, their wooden chairs, and their papyrus books, but we even find the bodies of the men who made and used these things; for their mummies are so perfectly preserved by embalming that we can compare their features with the portrait statues of their kings and see how well the sculptor caught the likeness (*see* Mummy).

The Rosetta Stone Supplies the Key

Much of this marvelous story would still be a sealed book to us if it had not been for the famous Rosetta stone, which gave scholars the key to the long-forgotten "hieroglyphics" in which the inscriptions and papyrus books were written. This is a thick slab of black basalt, about as large as the top of a sewing machine, discovered by Napoleon's soldiers while digging trenches near the Rosetta mouth of the Nile in 1799. On it is inscribed a record in honor of one of the kings of Egypt in 195 B.C., written in two languages—in Greek, which was then the official language of the government, and in Egyptian, both in the ordinary Egyptian characters (demotic), and in the ancient sacred hieroglyphics. By comparing the Greek translation with the Egyptian texts an ingenious French scholar named Champollion was able to discover the meanings of the ancient hieroglyphics and to begin the reconstruction of the Egyptian language. Other scholars took up the work, and thus the secrets have been discovered of the strange inscriptions over which scholars had so long puzzled in vain.

THE KEY TO THE STORY OF ANCIENT EGYPT



This is the Rosetta Stone that supplied the key to the meaning of the mysterious hieroglyphics in which the inscriptions of ancient Egypt were written. The stone is about as large as the top of a sewing machine and is a thick slab of black volcanic rock. The inscription on the stone was written in hieroglyphics, in ordinary Egyptian characters called "demotic" and, finally, in a Greek translation, and so the scholars were able to read this stone, and piece together a kind of hieroglyphic dictionary to be drawn on for reading other Egyptian writings.

Now, how did it happen that the Egyptians took such pains to preserve their bodies, their records, and the objects of their everyday life? The answer lies buried deep in their religion. "The Egyptians," wrote Herodotus, "are the most religious of all men." They believed, as the Christian does, that the soul lives on after death, and that it will be judged by the great god Osiris for the deeds done on earth. They also believed that the soul can return to its body, and eat the food and drink prepared for it, read the sacred texts, and enjoy the other comforts laid away in the tomb. So their earliest pharaohs—so the Egyptians called their kings—built themselves great brick-walled tombs in the ground, and by 3000 B.C. they had begun constructing enormous stone pyramids to keep their bodies safe through the ages.

Egypt United under King Menes

As we steam up the Nile, let us make our first stop at Thinis, near Abydos, about 350 miles south of Cairo. Here was born King Menes, the first pharaoh who ruled both Upper and Lower Egypt, uniting them about 3400 B.C. Before the time of Menes the dwellers in the low swampy lands of the Nile delta had also developed a civilization as high as that of the upper Nile, perhaps higher; for we know that in 4241 B.C.—*the first event in history to which we can give an exact date*—they invented a yearly calendar with 12 months of 30 days each, and five feast days at the end to make out the full 365. This is very much like the calendar we are still using, and it was a great advance over the early reckonings by moon months of 28 days. The shifting silt brought down by the Nile has long since buried hopelessly the remains of the early delta civilization, and we have to begin our story of Egypt far to the south.

At Thinis we go to see several underground brick-walled tombs, one of which may be that of King Menes himself. Ivory and ebony tablets and inscribed jewels—including a gold bar that belonged to King Menes—tell of the deeds of these earliest kings, of their well-organized administration, and of their wars with the desert tribes and other outside peoples.

The Pyramid Age (about 3000–2500 B.C.)

For the second great chapter in Egyptian history we have to go back down the Nile to the site of King Menes' ancient capital, the royal city of Memphis, about 12 miles south of Cairo. The city, once about 12 miles in circuit, was destroyed by the Arabs in the 7th century, and the sun-dried bricks of which it was built have long since crumbled into dust. Nothing remains but a few blocks of granite, sculptured fragments, and rubbish heaps.

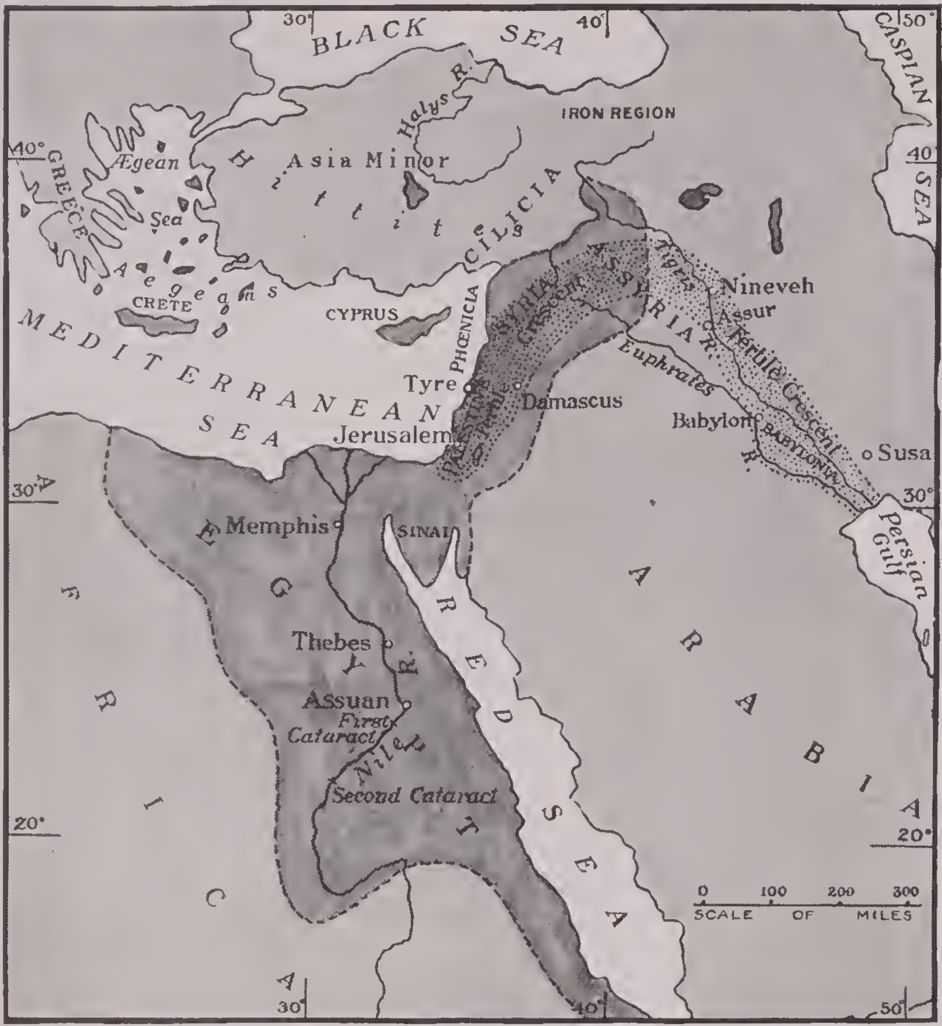
The city of the living has vanished, but not so the city of the dead. The colossal pyramids still stand which the ancient dwellers of Memphis built to protect the bodies of their kings. If we should soar in an airplane above the site of Memphis, we could see a straggling line of these vast edifices of masonry extending more than 60 miles along the Nile. Each pyramid marks the last resting place of one of the pharaohs of the Pyramid Age, which continued from about 3000 to 2500 B.C. The lonely chamber hidden deep within each of these piles once housed a royal mummy, bedecked with jewels and costly raiment. But ruthless hands ages since opened the sarcophagi (stone coffins) and robbed them of their treasures.

Near the site of Memphis we visit the oldest surviving building of stone masonry, the step-pyramid of King Zoser, erected not much after 3000 B.C. This earliest "pyramid" was really a series of flat tomb structures built one on top of the other in diminishing sizes, but it suggested the pyramid form.

Not more than a hundred years later King Khufu (or Cheops) was building the Great Pyramid in the cemetery of Gizeh opposite Cairo. This mass of masonry covers 13 acres, each side being 755 feet or nearly two blocks long, and the height nearly 500 feet. It contains 2,300,000 blocks of limestone, each as heavy as a large wagonload of coal. Herodotus says that 100,000 men spent 20 years building it, and modern archeologists believe it may have taken even longer. (*See* Pyramids.)

Scarcely less gigantic is the nearby pyramid of King Khafrē. Before it, endlessly sentineling the tomb, stands the great Sphinx, that riddle of the ages whose meaning we have only just learned. Now we know that the Great Sphinx of Gizeh was the portrait head of Khafrē, attached to the body of a lion, just as most of the other sphinxes of Egypt were portrait heads of other buried pharaohs. (*See* Sphinx.)

THE LAND OF EGYPT AND THE FERTILE CRESCENT



This map tells two important stories, one about how Father Nile was the making of Egypt, and the other about what is known as the Fertile Crescent. The earliest home of man in western Asia was on this crescent borderland between the mountains and the desert. And from here as well as from the Nile valley civilization spread to Europe.

Around the pyramids of the kings stand small flat-topped tombs of nobles and members of the royal house. As the pyramid had its temple, endowed with the income from many towns, so the tombs of the nobles had their chapels, where the priests served dinners of many courses for the mummy. Here, too, you will find the "pyramid texts"—prayers and incantations supposed to help the dead over the dangers of their long journey through the lower world. Later generations prepared a collection of these charms—on long papyrus rolls, some of them 90 feet long—and numerous copies of this have been found buried with the dead. From this fact the name 'Book of the Dead' has been given to this collection of religious texts.

Trade and Industry 5,000 Years Ago

The chapel walls are often covered from floor to ceiling with carved and painted scenes picturing the life of the great estate over which the noble once ruled. You see his herds of cattle, and watch the peasants hoeing and plowing and planting. You see also craftsmen working at their trades. Here is the coppersmith, hammering a saw out of a strip of copper; and there the lapidary who grinds out of diorite—a stone as hard as steel—bowls so thin they let the light through, or inlays turquoise into golden vases. Here also is the goldsmith making richly wrought jewelry; and the potter turning clay vessels on a potter's wheel and baking them in closed clay furnaces as tall as a man.

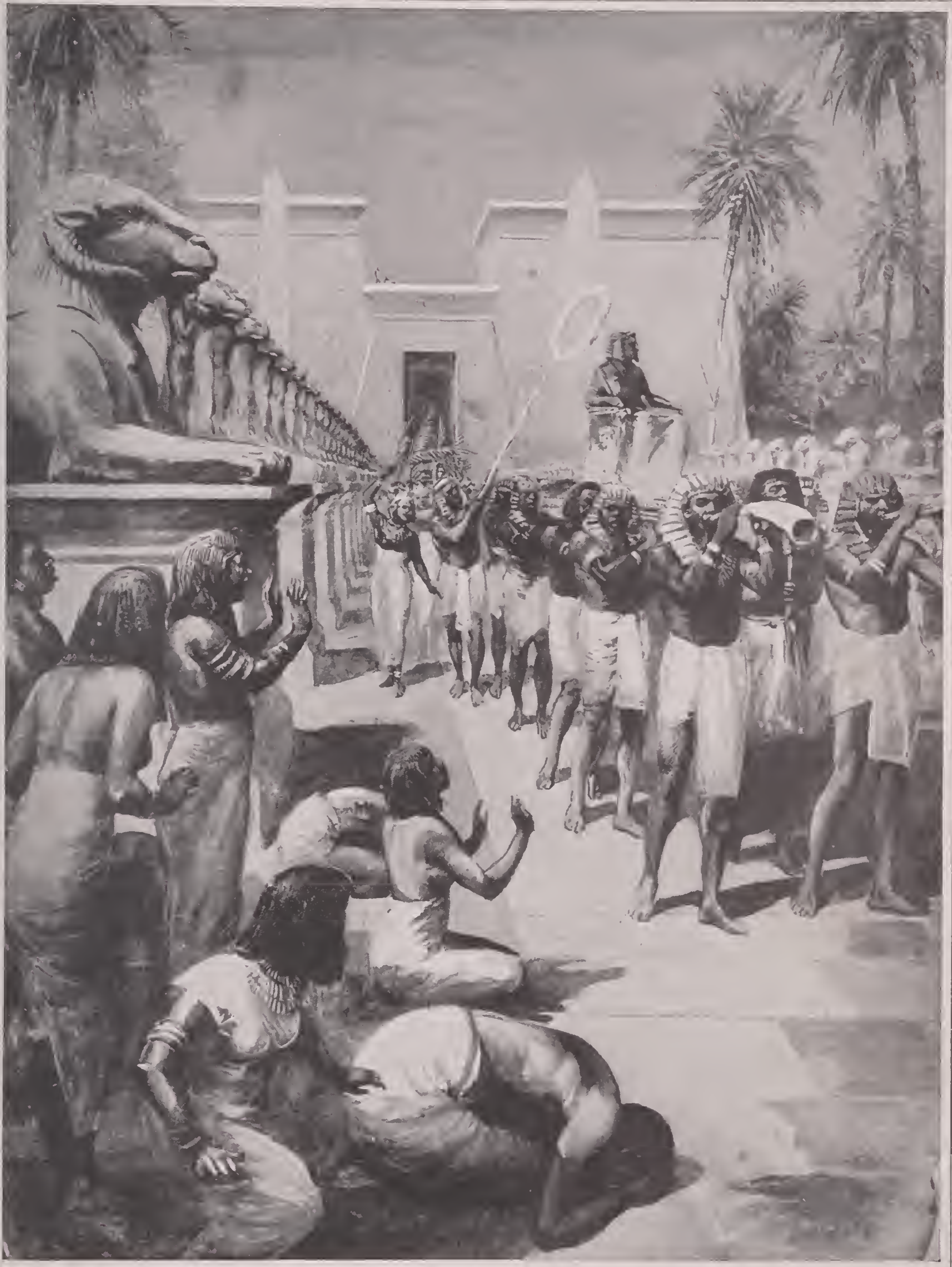
Glass, too, was made and used to glaze tiles, or fashioned into vases and bottles. Here, too, are weaving women making gossamer fabrics of linen, tapestries for the pharaoh's palace, or awnings for the noble's roof garden. Men are gathering papyrus reeds in the Nile marshes to split and paste together into strong double sheets of pale yellow writing paper. Ship-builders are making the typical Nile vessels with curving hulls, and cabinet-makers are busy upon chairs and couches to be overlaid with precious metals, inlaid with ebony and ivory, and cushioned with soft leather.

On another wall we find a scene in the marketplace. Coins had not then been thought of, so the people are literally trading. The cobbler offers the baker a pair of sandals in return for a cake, and the carpenter's wife gives the fisherman a little wooden box.

In the Pyramid Age art was developing as well as industry. The painter had learned to observe life closely and to paint it in brilliant colors, although he did not know how to draw in perspective or show objects as having thickness and roundness. The portrait sculptor could make marvelous likenesses in stone or wood, colored to the life and with bright eyes of rock crystal.

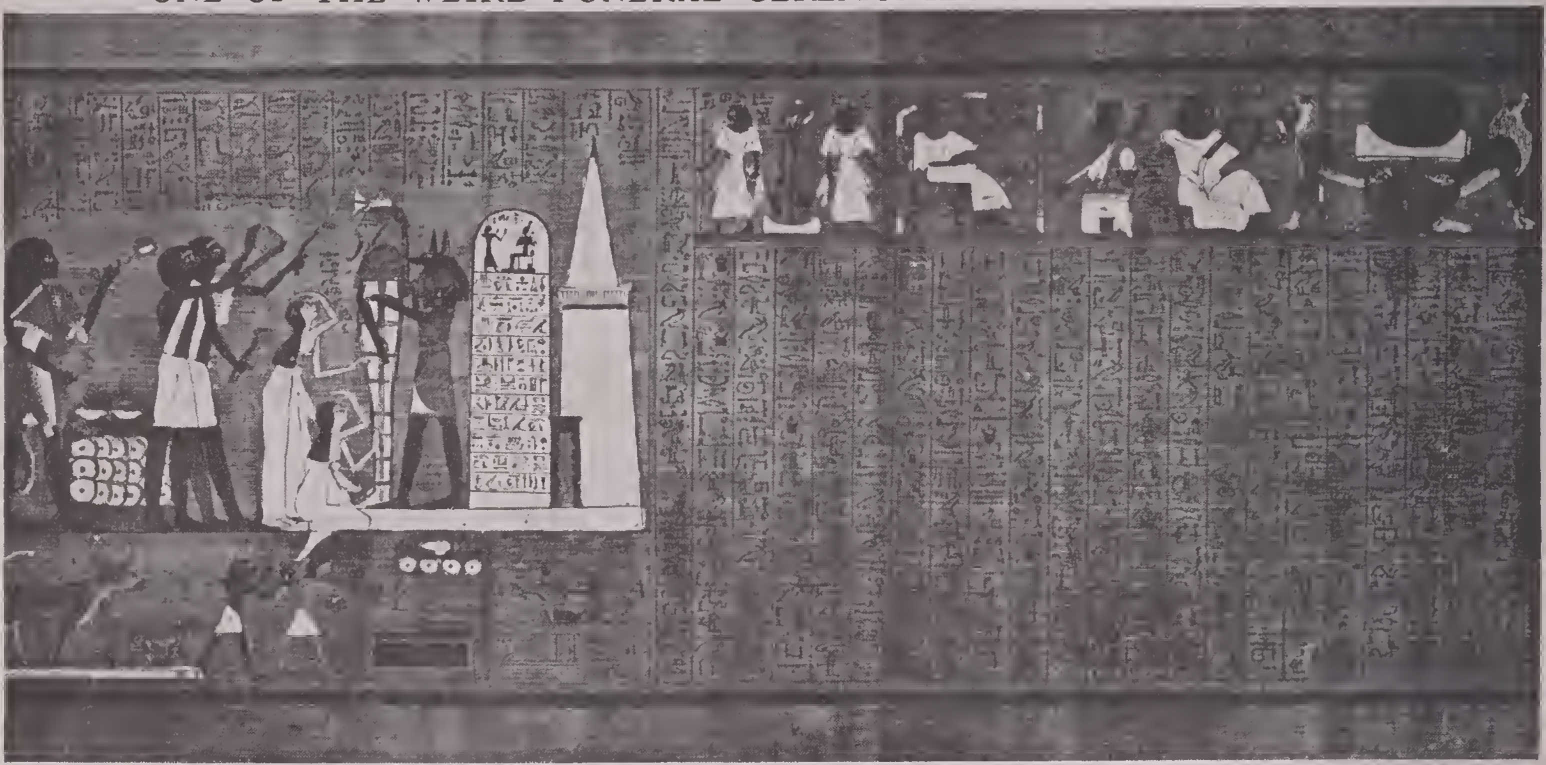
A glance at the massive temple standing near the pyramid of Khafrē shows us what progress the Egyptians of the Pyramid Age had made in the art of building. It is a splendid hall of granite with massive

PHARAOH ON HIS WAY TO THE TEMPLE



The magnificent temple of the god Ammon at Karnak was one of the greatest of Egypt's architectural achievements. To this sacred shrine of their religion, the Pharaohs went with music and with pomp. Here the Pharaoh has entered through the "pylon" archway between the two obelisks, and the procession is passing to the temple. The people are prostrating themselves, both because this is the sacred person of their ruler and because he was supposed to represent the whole nation when he appeared before the god in the temple. The queer looking figures of animals in rows on either side are sphinxes with ram heads, the ram being symbolic of Ammon.

ONE OF THE WEIRD FUNERAL CEREMONIES OF THE EGYPTIANS



When a mummy was laid away there was performed a ceremony known as "opening the mouth," which is here shown, the object being to supply the spirit of the dead with food and drink for its body in the other world. In this picture one priest is touching the mouth of the mummy with a certain instrument used in these ceremonies, and the other priest, standing beside him, is presenting vases of water. Behind these two is another official pouring out water for the dead, and burning incense. In later days a statue of the deceased took the place of his mummy in the ceremonies. This picture is from a drawing in the British Museum.

square pillars supporting the roofs which covered the three aisles—the central roof raised above the others. Openings in the walls which connected the middle roof with the lower roofs at each side admitted light, just as in the clerestory of the Gothic cathedral. In fact, this Egyptian temple nearly 5,000 years old, with its arrangement of three aisles and roof windows, contains the germ of the idea which the builders of early Christian days developed into the magnificent basilica and cathedral (*see* Architecture).

That the pyramid pharaohs were rich and powerful we can see from their ability to support the thousands of men at work on their monuments. Their treasuries consisted of storehouses and granaries, for taxes were paid in grain and live stock, wine, honey, and linen. At the central offices armies of clerks were kept busy with their reed pens and papyrus rolls. The pharaoh also sent donkey caravans to the Sudan for ebony, ivory, ostrich feathers, and fragrant gums, and ships to Phoenicia and through the Red Sea to the coast of lower Africa.

The Feudal Age of Egypt (about 2500–1800 B.C.)

The first great age of Egyptian civilization lasted about 500 years. A new epoch—which we may call the Feudal Age—begins about 2500 B.C., when the great nobles became powerful enough to wrest many privileges from the pharaohs, each ruling vast estates much as the barons did in the Middle Ages of Europe. To study this period we must sail about 200 miles up the Nile to the great cliff tombs overlooking the river, where the feudal lords are buried.

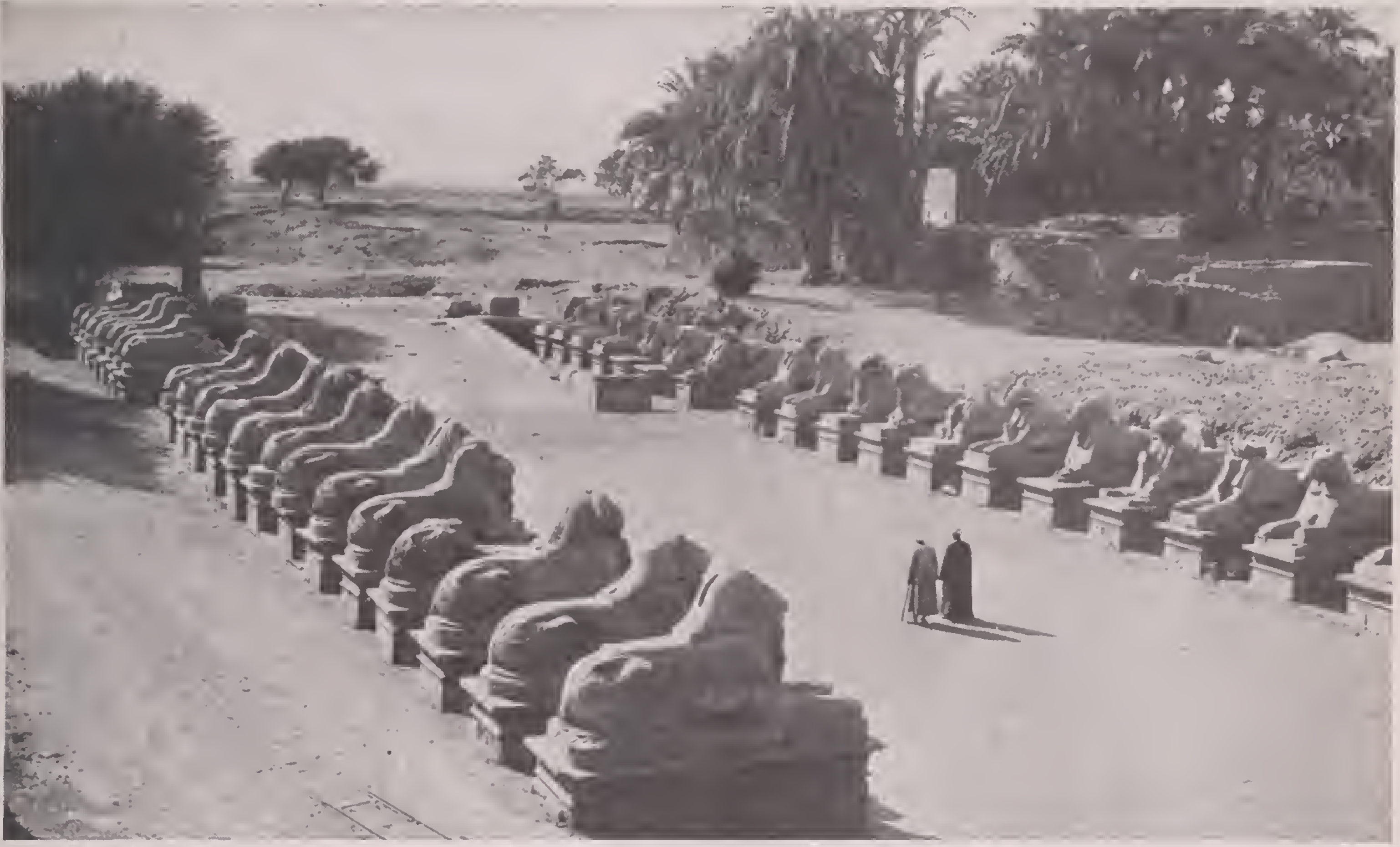
But even after visiting the tombs at the island of Elephantine, at Bersheh, Beni-Hasan, and Siut, we have caught only a glimpse of this period, for many of the most interesting objects discovered in the tombs were of the sort that must be moved instantly to museums for study and safekeeping. Among these are the oldest surviving books, rolls of papyrus once packed in jars neatly labeled. Some of them are story books, telling of shipwreck, of wanderings and adventures in Asia, or recounting wonder tales of old magicians. There are songs and poems in praise of the pharaoh, and a few works of science, including the oldest medical book we know of, a papyrus roll 66 feet long. In the tombs at Dashur were found the jewels of the princesses, among them a diadem of little flowers exquisitely wrought in gold. These are in Cairo. In the museums of Europe and America you will find some of the models of boats and of servants preparing food and beer.

The pharaohs of the time watched the Nile carefully and cut records of its various levels in the rocks. They built irrigation works, and dug a canal from the north end of the Red Sea to the nearest branch of the Nile. This served the purpose that the Suez Canal serves nowadays. They also kept a standing army and conquered Nubia as far as the Second Cataract, thus adding 200 miles of the Nile to the kingdom of Egypt.

The feudal period was at its height from 2000 to 1800 B.C. Its decline is marked by great confusion, usurper following upon usurper. Afterwards Egypt seems to have been ruled by a line of foreign kings who have been known for centuries as the Hyksos or shepherd kings. As the Hyksos ruled from the delta, their records and their capital will probably never be found.

About 400 miles above Cairo the Nile valley sud-

THE AVENUE OF THE SPHINXES TODAY



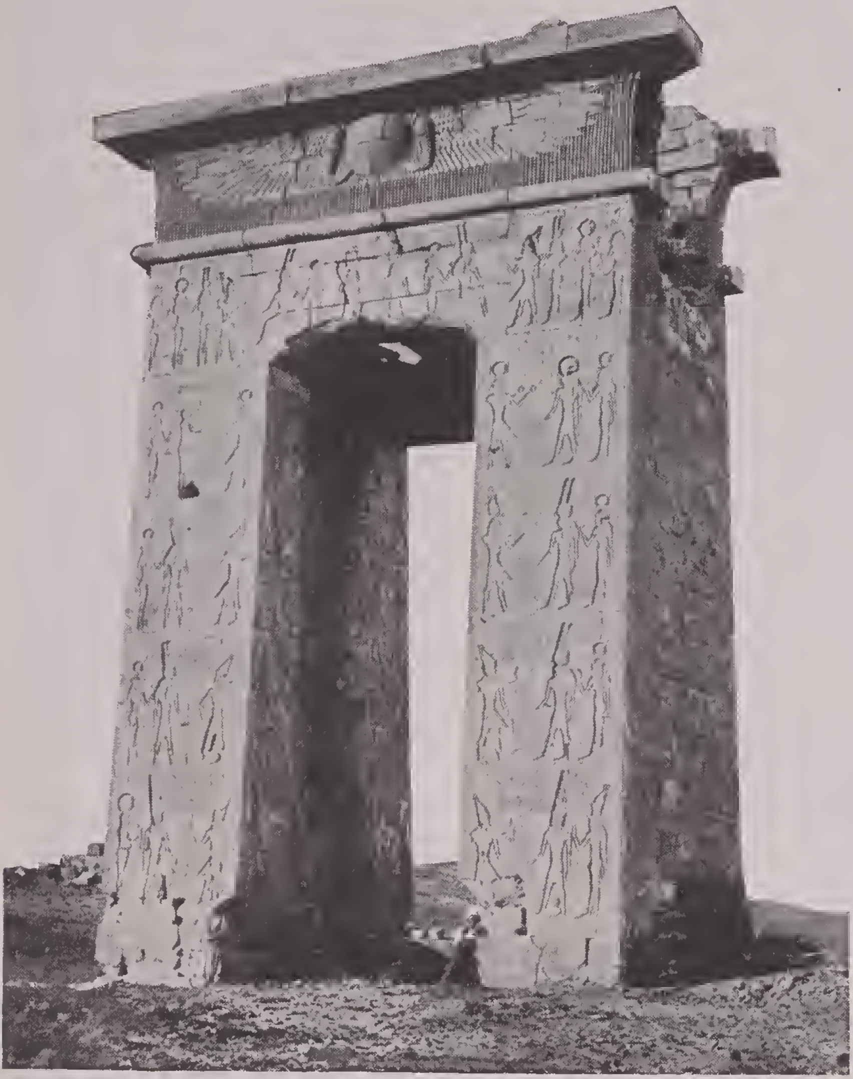
You have seen in a previous picture how the Avenue of the Sphinxes looked in the days when the Pharaohs were in their glory. This is how the avenue looks today. These sphinxes have the body of a lion and the head of a ram. When we think of sphinxes it is usually either of the sphinx at Gizeh, whose face is supposed to be the portrait of the Pharaoh who erected it, or of the Greek sphinx which had the face of a woman, the feet and tail of a lion, and the wings of a bird.

RAMESES THE GREAT OUT FOR A DRIVE

The kings and the nobles of ancient Egypt used to go out riding like this in their chariots, gorgeously appareled, and with their slaves leading in the procession lions which the royal hunters themselves had helped to capture. The distinguished person in this chariot is no other than Rameses II, who is supposed to be the Pharaoh who oppressed the Jews.

denly widens to a broad double bay in the hills. On our left we see masses of stone masonry and lines of tall columns, memories of dead kings, rising among the palm trees and the growing crops. On our right, cream-colored with blue shadows against the vivid orange cliffs, are the pillars of tomb chapels—for the Egyptians thought of the kingdom of the dead as lying to the west, just as the soldiers in the World War used to speak of "going west" when a comrade was killed. On the west also, dipping their vast feet in the Nile flood, or hiding them in the growing crops, are the two colossal statues of Memnon, so huge that beside them a man becomes as small as a kitten nestling in your lap.

AN EGYPTIAN PYLON



One of the most impressive features of Egyptian architecture was the "pylon," an example of which is here shown. This pylon stands before the Temple of Karnak. On the pillars are inscribed scenes from the lives and deeds of Egyptian kings, just as on the arches of the Romans and the arches of today are told in sculpture the deeds of those in whose honor the arches are erected. Above the arch of the pylon is the Egyptian "winged sun."

This is the plain of Thebes, and here we must remain many days to study the greatest period of Egypt—from the 16th to the 12th century B.C.—when the government was no longer a little valley kingdom, but an empire ruling from the Euphrates in Asia to the Fourth Cataract of the Nile. The modern center of the plain is Luxor, with its double row of columns along the Nile, its hotels, and the Arab village creeping up into the temple precincts. To the northeast lies Karnak. This tangle of vast temples built by various pharaohs is approached from the Nile by a broad avenue of ram-headed sphinxes. Karnak contains the greatest colonnaded hall ever erected. The columns of its central aisle are 69 feet high, and so large that 100 men could stand on the top of each. This one room covers as much space as the whole cathedral of Notre Dame at Paris. Near by stand sculptured figures cut from a single block 80 or 90 feet high, weighing as much as the entire load of a modern freight train. Sculptures in relief tell of Egyptian wars in Asia. Here for the first time we find the horse represented in sculpture, and so we are able to tell about when it began to be used in Egypt.

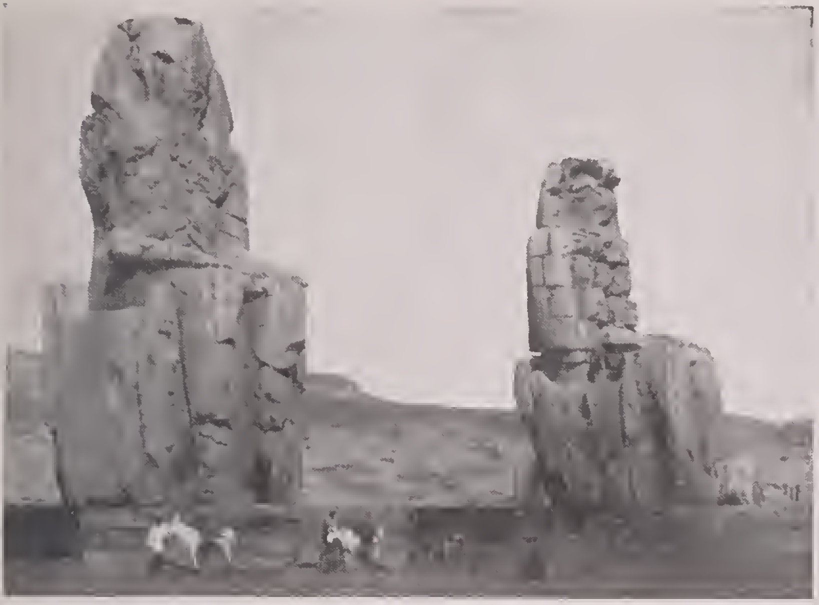
Within the precincts of Karnak and the many other great temples of ancient Egypt once dwelled an army of priests supported in idleness by immense endowments. Successive rulers lavished riches on the priesthoods, until they became great corporations, possessing vast wealth and landed estates worked for them by serfs. The power of the priesthoods was increased by the fact that they were the only learned class and were believed by their superstitious followers to have magical powers. The kings usually believed in the superstitions fostered by the priesthood, but whether they did or not, they supported the priests who in turn supported the royal power.

At Thebes the Egyptian kings and queens first become real people for us. Some of their tombs, tunneled into the rocks for a quarter of a mile remained unopened almost to our own day, and many of them have been left just as they were discovered. Through guarded doors you may pass through chambers and corridors to the central tomb

A MUMMY LEFT AT REST

Most of the stone coffins containing the mummies of the old Egyptian kings have been robbed of their contents, but here is one that can still be seen on a mountain near Thebes. Don't you wonder what that old king would think, if he could wake up and see that electric light?

THE STATUE THAT USED TO SING



Those two great statues of Amenhotep III standing near Thebes look very much alike, but the nearer one has a curious history. It was called "Memnon" by the Greeks, after a Greek god, and used to sing every morning, according to the report of the old Greek travelers. This singing is explained by the air inside it, warmed and expanded by the sun's rays, forcing its way through the pores of the stone. The Romans attempted to mend the statue in 170 A.D. and the singing ceased.

chamber, where the mummy lies in his sarcophagus, surrounded by furniture and jewelry. The ceiling is painted with stars and the walls are covered with pictures and hieroglyphic writing that tells of the dead king's deeds.

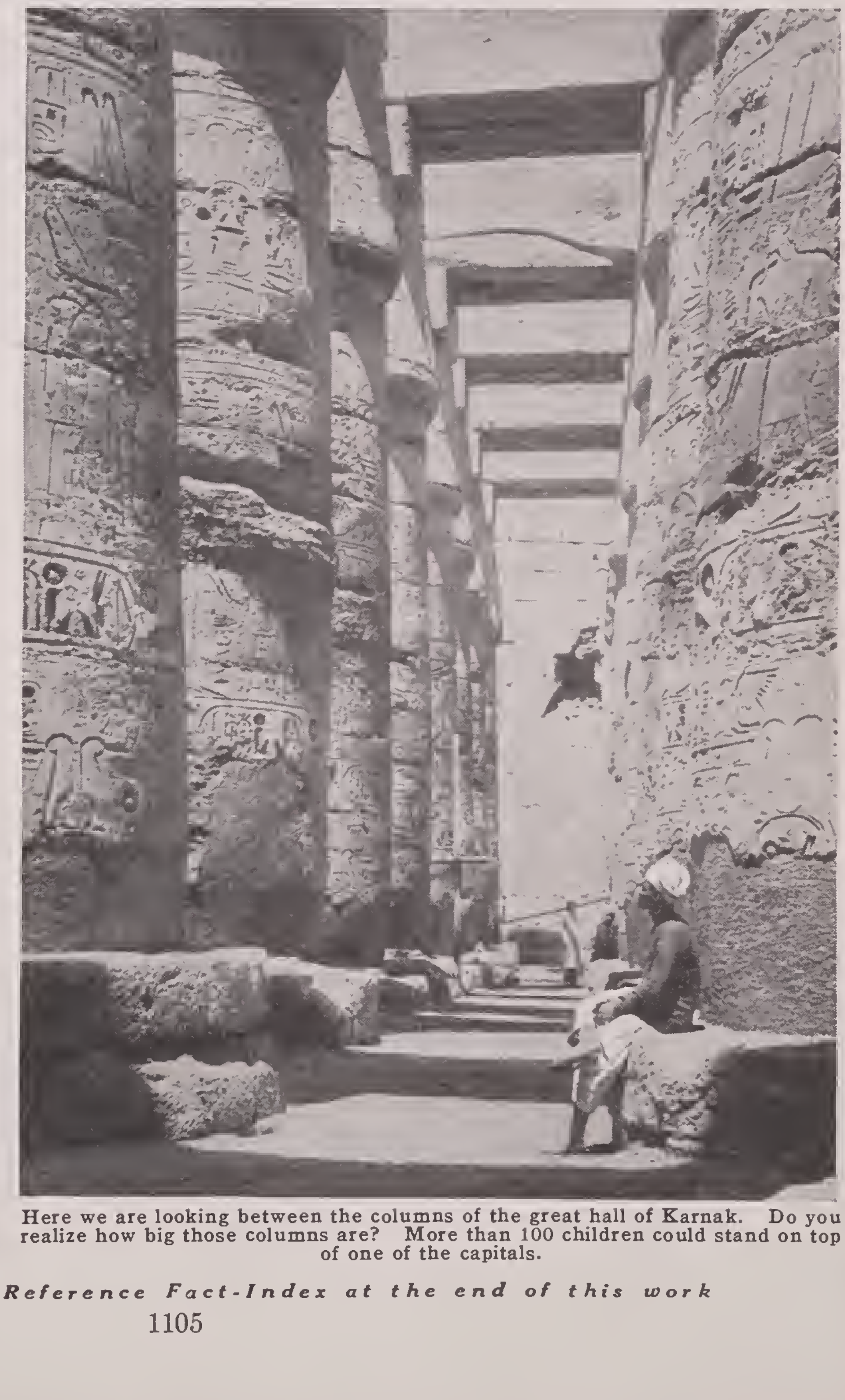
One of the most sensational of the excavations was made as recently as 1905, when the tomb and temple of Queen Hatshepsu were dug out of the sands. She was the first great woman of history, living about 1500 B.C. In the wall paintings of the dainty little temple, whose orange pillars at the foot of the cliffs are seen from the river, one may read her whole story from birth. We may participate in the wonderful expedition she sent to strange lands, and watch her mighty obelisks float down from the First Cataract in long Nile barges. These shafts of stone nearly 100 feet high, 8½ feet at the base, and weighing nearly 370 tons, would be a problem for the modern engineer to move. Smaller obelisks, however, have been moved from Egypt, notably the so-called "Cleopatra's needles" in New York and London. You have perhaps seen one and can remember how it tapers to its pyramidal top and how its sides are covered with pictures and hieroglyphic writing.

Hatshepsu's successor, Thutmose (or Tethmosis) III—the Napoleon of ancient Egypt—also becomes a very real person for us. In his reign of more than 50 years, he conquered western Asia and made one of his generals governor of the Aegean islands. For some reason—possibly to wipe out the memory of the hated rule of a woman—he erased the name of Queen Hatshepsu from the monuments wherever he could, and walled up her great obelisks, one of which is still standing at Karnak with some of the concealing masonry clinging to its base.

Perhaps the most attractive figure of this period is that of the young king Ikhenaton, son of Amenhotep III. He abandoned the ancient belief that there were many gods (polytheism) and tried to convert his people to the belief in one god (monotheism).

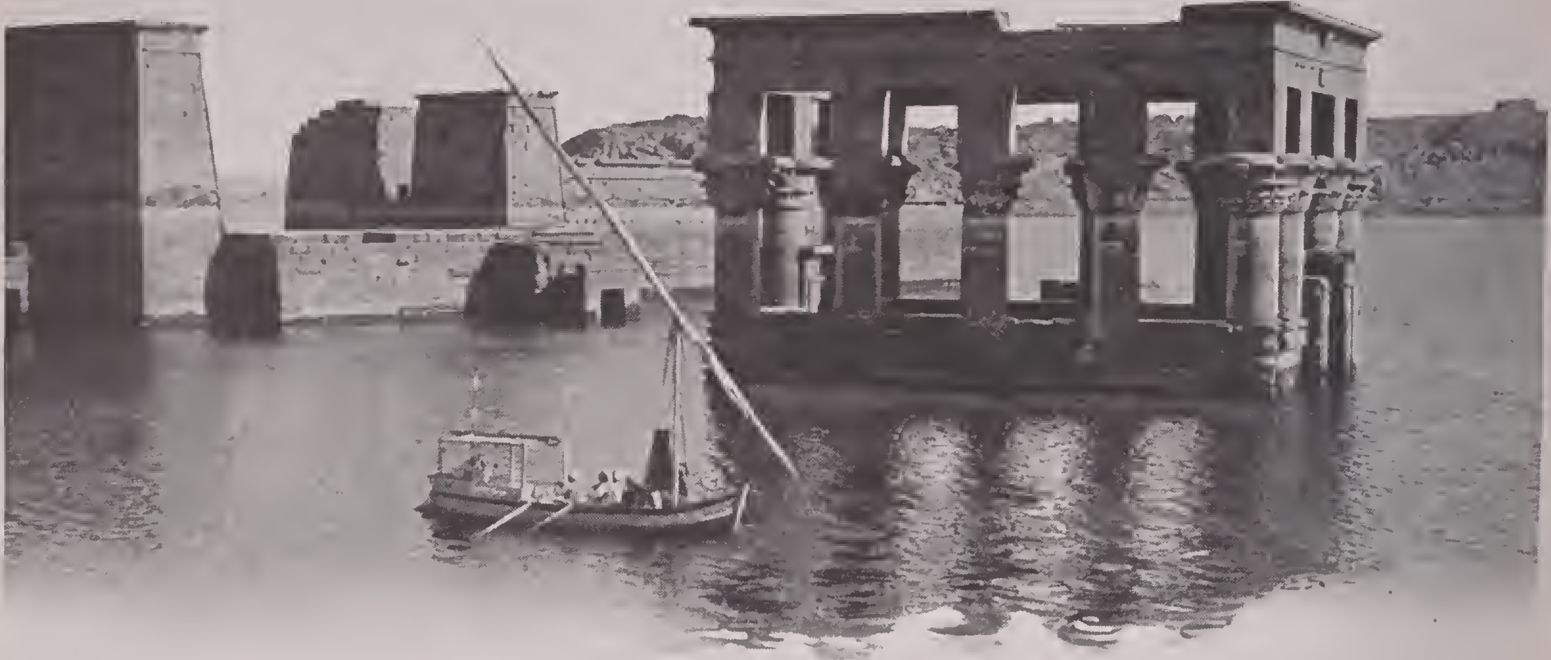
The number of deities in the Egyptian religion was prodigious, for at first every village seems to

IN THE GREAT HALL OF KARNAK



Here we are looking between the columns of the great hall of Karnak. Do you realize how big those columns are? More than 100 children could stand on top of one of the capitals.

THE BEAUTIFUL RUINS OF PHILAE



These are a portion of the beautiful ruins on the Island of Philae in the Nile. You can only see them during a small part of each year. The rest of the time they are covered by the waters of the Nile which collect behind the great Assuan Dam.

have had its own god or gods. Gradually most of the deities of the smaller communities had been forgotten, and there remained only the great gods of the principal cities. These were usually worshiped under the form of some animal, and in some places animals of these sacred classes were mummified after death. Vast cemeteries of mummified cats have been found at Bubastis, and crocodiles, lizards, bulls, ibises, and many other animals were similarly treated at various places and times. Chief among the Egyptian deities were the falcon-headed sun-god Re, worshiped in later times as Ammon-Re; Osiris, judge of the lower world, incarnated on earth in the sacred bull Apis (*see* Osiris); Isis, sister and wife of Osiris, represented by the cow (*see* Isis); Ptah, a craftsman and artist (like the Greek Hephaestus) and one of the creators of the world.

For these diverse and primitive cults, Ikhenaton attempted to substitute a single form of worship, the adoration of the power of the sun. Despairing of accomplishing anything among the many temples of the old worship at Karnak, he moved his capital to Amarna. There in a sculptor's ruined workshop has been found a portrait statue showing him as having the beautiful face of a dreamer. At Amarna also were found the famous "Tel-el-Amarna letters"—baked clay tablets inscribed with cuneiform characters—from the kings of western Asia to the pharaoh. These show us how the northern territory in Syria was being taken by the Hittites coming in from Asia Minor, and the southern by the Hebrews drifting in from the desert: The Hittites possessed weapons of iron, and this gave them a tremendous advantage over the Egyptians, who had only bronze weapons and tools.

RAMESES II

This is a statue of Rameses II, made from red granite. It was found among the ruins of the temple at Luxor.

But before the Egyptian empire fell, it flared up into one last blaze of glory under Seti I and his son Rameses II, the most famous of the pharaohs. If we had been casually voyaging up the Nile instead of sailing in search of history, we might easily have supposed that Rameses II was the only pharaoh Egypt ever had. From the Delta to the great rock temple of Abu Simbel in Nubia, where his colossal portrait statues look down from the cliff, his name is upon almost every building. He was the greatest builder of all the rulers of Egypt, but he also put inscriptions upon many buildings erected by his ancestors.

Rameses II reigned for 67 years, from about 1292 to 1225 B.C., waging long wars in Asia which restored much of Egypt's lost prestige there. He may have been the pharaoh who so grievously oppressed the Israelites, as we read in the Bible.

But the time now came when Egypt was to be the conquered instead of the conqueror. The country was subdued by the Assyrians in the 7th century, and by the Persians in the 6th. It remained a Persian province until 332 B.C., when Alexander the Great seized it.

Alexander's conquest meant for Egypt a new great age, for under Ptolemy I—the Macedonian general who took Egypt as his share after the death of Alexander—and his descendants, it was again ruled not as a province but as an independent country. Alexandria, the harbor city which the Ptolemies took as their capital, became the greatest commercial port on the Mediterranean (*see* Alexandria), and Egyptian fleets ruled the seas from the Indian Ocean to the Hellespont. The Ptolemies also reconquered Palestine and southern Syria, and made Alexandria the literary and scientific capital of the world as well as a commercial center.

That beautiful city, however, lies buried far under the busy modern city of Alexandria, so perhaps the best way to get a glimpse of the last great chapter of Egypt's long history is to travel still farther up the Nile to the island of Philae, above the great dam at Assuan. The Ptolemies left many temples, new or remodeled, along the Nile, but none more exquisite than the temple of Isis among the palms of Philae, which is now under water the greater part of the year.

After the famous Cleopatra, seventh and last of the Ptolemies, Egypt became a Roman province (*see* Cleopatra). During the early centuries of the Christian era Alexandria was the world's chief center of learning and Christianity. But in the chaos that followed the barbarian invasions of the Roman Empire, Egypt fell an easy prey to Saracen conquest (641 A.D.) nine years after the death of Mohammed. Since that time Mohammedanism has ruled in the land of the pharaohs. Six centuries later the last remains of ancient Egyptian civilization and greatness disappeared under the despotic rule of the Mamelukes—Circassian slaves brought in to serve as mounted soldiers, who in 1240 overthrew the rule of the califs and made one of their own number sultan.

Early in the 16th century the Ottoman Turks under Selim I ended Mameluke rule, but failed to subdue the Mameluke *beys* or provincial governors, who kept Egypt in confusion for 300 years more by wars against the Turks and among themselves. Their power was at last broken by Napoleon at the Battle of the Pyramids (1798) and most of the survivors were soon after massacred by the Turks.

ELBE (*ĕl'bē*) **RIVER.** Although the Elbe, Germany's second river in importance, cannot rival the Rhine in the beauty of its landscape, there is much to charm the eye in the picturesque cliffs near Dresden, which have given to that district the name of "the Saxon Switzerland." Rising on the Bohemian side of the Riesingebirge, the Elbe wanders for 150 miles in that alien country before it breaks through the Erzgebirge and reaches the German plain on its northwesterly course to the North Sea. Passing Dresden, the Saxon capital, one reaches successively Wittenberg (full of Lutheran memories), Magdeburg, and many other towns and villages, where the banks of the river are low and one sees the country far and wide. Old windmills wave their arms against the horizon, peasants' huts peer from vines along the water, and storks and cranes stand on the banks watching your movements.

The total length of the Elbe is 725 miles, with about 525 miles navigable. Of its many tributaries the most important are the Moldau and Eger (in Bohemia), and the Mulde, Saale, and Havel (in Germany), and in connection there is a fine system of canals. The navigation was formerly hindered by all sorts of tolls, but these were all abolished in 1870. Before the World War the lower course of the river was alive with ships from every part of the globe, carrying cargoes to and from Hamburg, Germany's greatest seaport (*see* Hamburg). That city lies 75 miles above the wide mouth of the river, at Cuxhaven on the North Sea, but the river bed has been constantly dredged and deepened to admit ocean vessels. Smaller vessels and great barges follow its course clear across Germany into Bohemia. An interesting invention is the great "towing chain," laid along the bottom of the river for 400 miles, from Hamburg to Aussig in Bohemia, along which vessels travel. The chain is stationary in the river bed, and the vessels simply loop it up over revolving drums on their decks, thus pulling themselves along by their own power.

ELDER. The white clustered blossoms of the shrubby elder plant that adorns our country lanes in June are far more beautiful than many a carefully-nurtured darling of the hothouse. Following these small fragrant flowers are the heavy juicy clusters of dark red, purple, or black berries that in old-fashioned households were made into spicy elderberry wine. Of the twenty or more species of the elder, five are native to the United States. They range from Nova Scotia to the Gulf of Mexico, and westward some 2,000 miles. The most common is the American elder which grows profusely in rich, moist soil throughout the eastern states. Another species, the beautiful red-berried or mountain elder (*Sambucus pubens*), makes its home especially in rocky uplands; its stem is much more woody than the common elder, and its flowers form clusters that are pyramid-shaped.

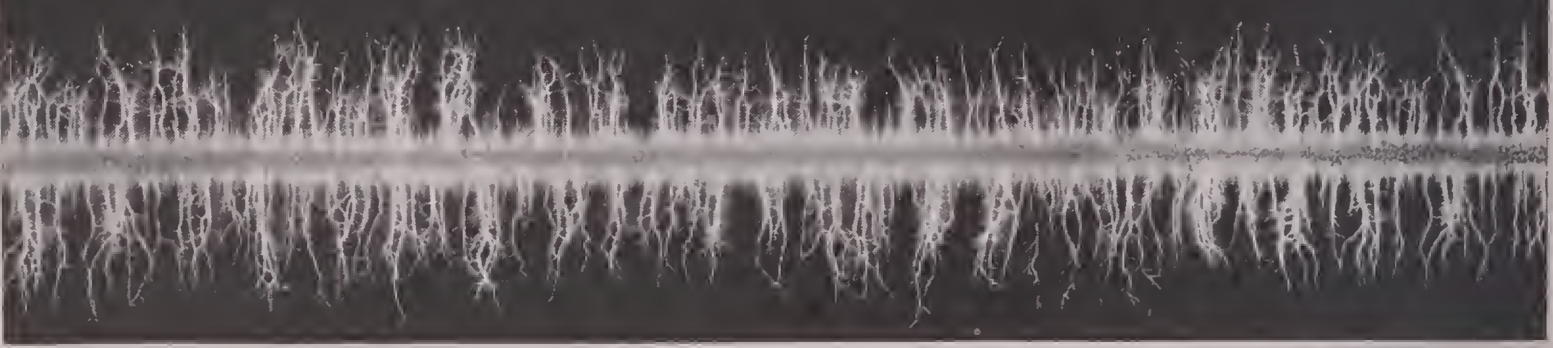
Scientific name of American elder, *Sambucus canadensis.* Flowers growing in flat-topped clusters at ends of branches; tiny calyx and corolla of 5 spreading lobes; 5 stamens; 3-parted style. Stem smooth, pithy, 4 to 10 feet high. Leaves opposite, pinnately compound, with usually 7 oval pointed ragged-edged leaflets.

ELECTIONS. It has been said that if three men of Anglo-Saxon race were cast away on a desert island, they would hold an election and form a government. English-speaking peoples are so familiar with elections—class elections, club elections, as well as political elections—that they organize meetings and hold elections instinctively.

In the United States most states have primary elections of the political parties to nominate candidates (*see* Primary Elections), as well as the ordinary elections for electing local, state, and national officers or passing on measures submitted to the people. Most elections are now by secret ballot (*see* Ballot). Election officials are sworn and their expenses are usually paid out of the public treasury.

In some elections the person or measure must receive an actual majority of all votes cast to be successful. Thus, if A receives 100 votes, B 80, and C 60, A has not a majority, as he received only 100 votes out of 240, or less than half of the total number of votes cast. If A had received 200, B 80, and C 60, A would have a majority of 30. In most elections, a plurality only is necessary for the candidate to win. In the first instance above, A has a plurality of 20 votes over the next highest candidate, and so would ordinarily be declared properly elected.

The "FIRE OF HEAVEN," *Man's* FRIEND *and* FOE



Have you ever seen an electric current? It is safe to say, you have not; but the photographic plate can "see" it when the current is of the "high tension" type. That is, it can register the almost invisible "leaks" from a highly charged wire, as this picture shows.

IN far-off days when the lightning flashed men cowered in mortal fear of the fire of heaven, the weapon of the terrible Thunderer which lesser gods might not touch. Ages passed, and the "fire of heaven" was found to be sleeping in earthly objects everywhere; men learned to waken it out of amber and glass and metals and make it do their bidding. Today, under the name of Electricity, it makes the family's toast for breakfast; it does the family washing; it runs the housewife's sewing machine and the fan that keeps the office cool in summer; it drives our street-cars; it puts "a girdle 'round the earth in 40 minutes"—or less—to bring us messages over wires or through the air. We buy it in measured quantities like milk or molasses. We have coined technical terms so that we may talk about it easily and familiarly.

Yet behind the tamed and docile front of our subservient drudge lies more of mystery and wonder than was hinted in the wildest of the old myths. For now we see in the electric current the flux and flow of matter itself. In the seemingly solid wood and metal and stone we see as it were a maze of countless infinitesimal universes—electrons whirling about electrons in atomic solar systems, atoms jostling atoms in the dance to form miniature constellations of molecules. And ever and again we see the streaming flight of electrons torn loose from their orbits to flash in an electric current across the yawning interstices of matter in an electric conductor, as a stream of meteors flashes across the sky. Electricity is thus the very stuff of matter itself—the warp and woof of the material universe. Who would not wish, then, to know all that we can know about this marvel which serves us in so many ways, after endowing us with our very bodies and the universe about them?

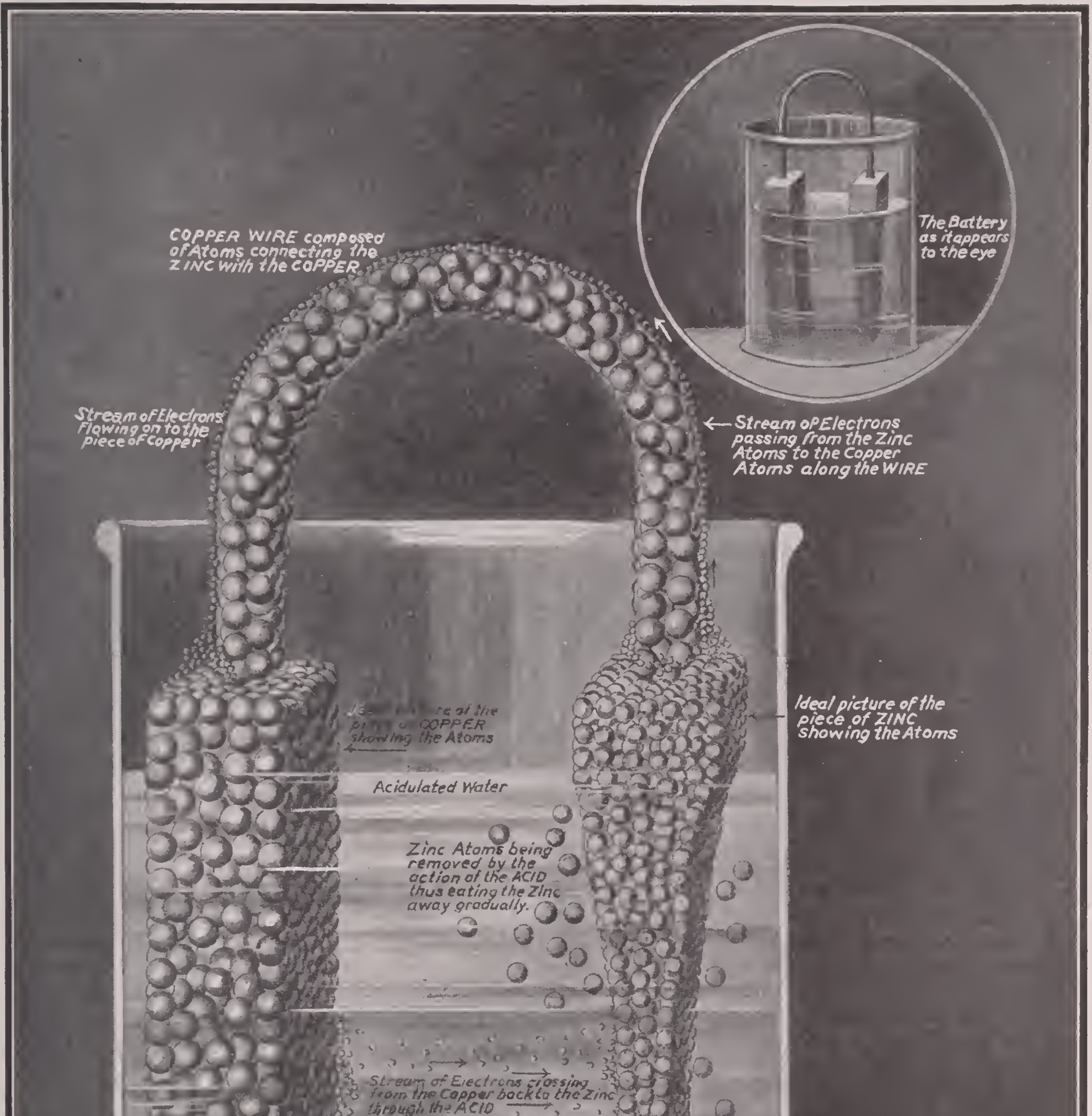
ELECTRICITY. Rub the rubber barrel of a fountain pen on flannel or fur, and the hard rubber becomes electrified; that is, there is electricity on the rubber. This is shown by its attraction for little pieces of paper, or for bits of pith, these light particles being drawn to the hard rubber. Many other substances show electricity by friction. Thus, sulphur rubbed on wool, sealing wax on fur, glass on silk, become electrified. This electricity we call frictional, or more commonly, "static" electricity.

While we know this electricity first by its attraction for light particles, it can produce sparks under proper conditions. Thus, in winter the friction of the leather soles of our shoes on the woolen rugs in our heated houses often produces enough electricity so that sparks jump from a person's finger to a metal hinge or lamp fixture. It is charges of static electricity that cause the brilliant lightning discharges between clouds or from the clouds to the earth.

There is a second and entirely different way of getting electricity, namely, by batteries and dynamos. By joining three or four common "dry cells" with wires to a small 6-volt electric lamp, the lamp filament is heated until it gives off light. A toy electric motor can also be run by connecting it to a battery. The lamp bulbs in our houses are lighted by electricity when connected to the wires coming from the power house, where electricity is generated by dynamo machines. The same electricity is used to drive street-cars and to run electric motors for machinery. This electricity from batteries and dynamos we call "current" electricity.

At one time it was not known that static electricity and current electricity were the same thing. But we now know that they *are* the same thing; that static electricity is *electricity at rest*, and that current electricity is *electricity in motion*. It is somewhat like the difference between water at rest in a tank or

THE SECRET OF THE ELECTRIC CURRENT


COPPER WIRE composed of Atoms connecting the ZINC with the COPPER
The Battery as it appears to the eye
Stream of Electrons flowing on to the piece of Copper
Stream of Electrons passing from the Zinc Atoms to the Copper Atoms along the WIRE
Ideal picture of the piece of COPPER showing the Atoms
Ideal picture of the piece of ZINC showing the Atoms
Acidulated Water
Zinc Atoms being removed by the action of the ACID thus eating the Zinc away gradually.
Stream of Electrons crossing from the Copper back to the Zinc through the ACID
Acidulated Water

A few years ago the question, "What is electricity?" found scientists practically without an answer and was supposed to be a "stone wall" which they could not penetrate. But now science has an answer, and here is a picture of it. In the sketch the artist has drawn spheres to represent the atoms of matter in the plates and wires of the cell, but each sphere is supposed to be made of electrons, as explained in the article. In looking at the picture we must remember that the artist has made both atoms and electrons large enough to see, but that really they are many millions times smaller than the little spheres in the drawing. The generation of electricity begins with the plate on the right, which is of zinc. When the acid in the water attacks this zinc, particles of zinc are broken away to combine with the acid. These zinc particles carry with them an excess of positive electrons; and since these positive electrons are no longer in the plate to "tie down" negative electrons, a corresponding number of negative electrons are set free within the plate. In the meantime, however, a process somewhat the reverse of this has taken place at the copper plate, and the copper plate bears an excess of positive electric charge in consequence. Since negative electrons flow freely through conductors, the free negative electrons in the zinc plate at once pass over the wire to join the free positive charge in the copper plate, and their passage is what we call "electric current." So long as the chemical process continues, therefore, the flow of electrons will continue; that is, the cell will continue to produce "current." The number of electrons necessary to accomplish this may be judged if you remember their small size. If a photographer should enlarge a coin sufficiently to give an atom the size of a clover seed, the coin would be six hundred miles across, and even then the electrons, which are much smaller, would be absolutely invisible.

reservoir, and water in motion in a stream. It is not until the water flows and thus exerts moving force on the water wheel that we get power from the water. The water in the tank exerts pressure, but unless the tank is a large reservoir we can get no continuous current or stream of water. We can think of the electricity of friction or static electricity as having a high pressure ("potential" or "voltage"), but with such a small quantity that it gives a simple "squirt" or spark discharge, but no continuing current. On the other hand, the electricity from the battery has low pressure or "head" ("potential" or "voltage"), but is relatively large in quantity, and thus can give a continuing flow or current. In many modern power plants we have dynamo machines which generate large quantities of electricity with high pressures ("high potentials" or "high voltages"), thus producing electric currents, but also showing many discharge and other effects that were supposed at one time to be seen only in frictional or static electricity. That part of the science of electricity which tells about electricity at rest is called "electrostatics." That part of electrical science which tells about electricity in motion or electric currents and their effects is called "electrodynamics" or "electrokinetics."

In this simple electroscope the swinging pith-ball moves in obedience to electric charges.

In this article we can give only a few of the main facts about static and current electricity. While the science of electricity is practically only about 150 years old, it is already a big science and is increasing with amazing rapidity.

The first effect of static electricity which was discovered was the attraction (and repulsion) which it exerts on light particles. Any instrument used to show the presence of electricity by its static force is called an "electroscope." The simplest electroscope is a small pith ball hung by a fine silk thread, the ball being attracted by a hard rubber or glass rod which is electrified. The most sensitive electroscope is the gold-leaf electroscope, which consists of two pieces of gold leaf (or aluminum leaf) hung alongside each other from a metal rod. The leaves are protected from air drafts by a bottle or a box with glass sides. The upper part of the rod ends in a brass plate or ball. The gold leaves diverge when a body with static electricity on it is brought near the plate.

If you mount a metal ball on a hard rubber stand, or on a glass stand, and touch the ball all along a hard rubber rod which has been electrified by friction, you will find by the electroscope that the electricity has been transferred to the metal ball. This electricity escapes to the ground if the ball is connected to the ground by the wire. It will also escape to the ground when touched with your hand, but it does not escape along a rubber or a glass rod. That is, electricity flows freely along a metal wire, or the human body, but does not flow along rubber or glass. A substance which allows electricity to flow through it is called an electrical "conductor," and a substance which does not allow the flow of electricity is called a "non-conductor" or "insulator." All metals are good conductors; rubber, glass, sulphur, mica, and silk are good insulators. Paper, dry wood, and cotton thread are very poor conductors, but are not high grade insulators. Wet substances are fairly good conductors for static electricity. You can understand why the metal ball is mounted on a rubber or glass stand, when it is desired to hold electricity on it; that is, to insulate it so it can retain an electric charge. A metal ball or a gilded pith ball, hung by a silk thread, is insulated and holds a charge.

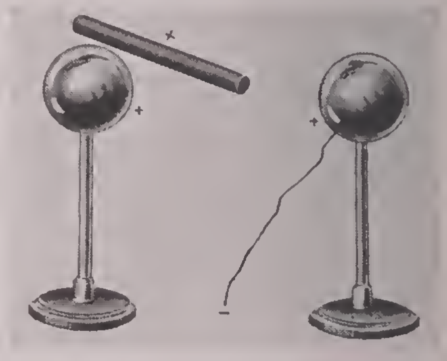
Electricity Positive and Negative

Electrify a hard rubber rod by rubbing it with fur, and suspend this electrified rod by silk threads. Now bring up a second rubber rod. The two electrified rods *repel* each other. Next bring up a glass rod which has been electrified by rubbing with silk, and the electrified glass rod *attracts* the electrified rubber rod. Now suspend the electrified glass rod by silk threads and bring up a second glass rod which has been electrified by friction with silk; the electrified glass rods repel each other, as the rubber rods did before.

It is very evident that hard rubber electrified by friction with fur acts opposite to glass electrified by friction with silk. We call the electricity on the glass from friction with silk "vitreous" or "positive" electricity, and the electricity on the hard rubber from friction with fur "resinous" or "negative" electricity. That is, there are two kinds of electricity, positive and negative. The rule is: *like* kinds of electricity *repel* each other, *unlike* kinds of electricity *attract* each other.

Gold Leaf Electroscope.

Charge two insulated bodies, the first with positive electricity, and the second equally with a negative electricity. Touch the two bodies, and the bodies are found by an electroscope to be discharged. That is, a body with equal quantities of positive and negative electricities shows no electrical force. The body shows no electrical effect, not because it has no electricity, but because it has equal charges of the two opposite kinds of electricity.



This illustrates the difference between Insulators and Conductors. The ball on the left retains its charge, because it is mounted on glass. The wire discharges the ball on the right.

HOW ELECTRICITY IS MADE BY FRICTION

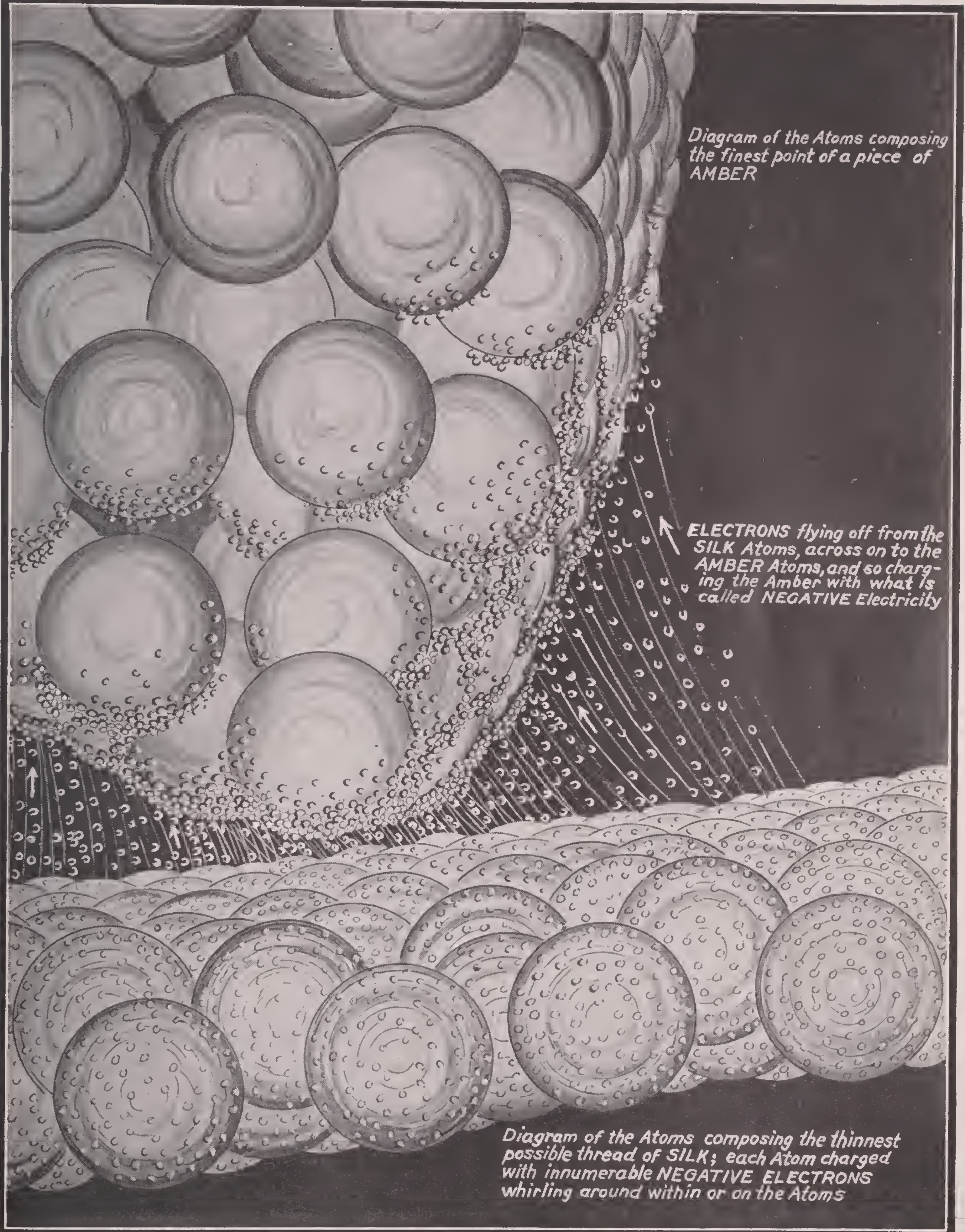
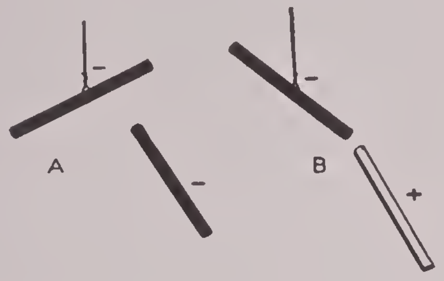


Diagram of the Atoms composing the finest point of a piece of AMBER
ELECTRONS flying off from the SILK Atoms, across on to the AMBER Atoms, and so charging the Amber with what is called NEGATIVE Electricity
Diagram of the Atoms composing the thinnest possible thread of SILK; each Atom charged with innumerable NEGATIVE ELECTRONS whirling around within or on the Atoms

Ever since the electric properties of amber were discovered many centuries ago, there have been theories of all sorts to explain its action. This picture shows how the "electron theory" does it. According to this new "electron theory," when amber is rubbed on silk or wool, a host of negative electrons on the silk are disengaged, and fly to the amber. Their presence on the amber gives it a "negative" charge. Meanwhile the positive electrons of the silk, freed from the neutralizing effect of the many negative electrons which have passed to the amber, exert their attractive power, and thus the silk bears a so-called "positive" charge. So long as either body remains isolated, and cannot obtain electrons with which to neutralize its excess electrification, it will remain "charged," and in its efforts to attract electrons will pick up light bodies such as bits of paper.

The first person to give us a real theory of electricity was Benjamin Franklin, one of the greatest of American statesmen and also a notable scientific man of his time. About 1750, Franklin stated his theory, called Franklin's "one fluid theory," because he said electricity is an invisible weightless *fluid*. A fluid is a substance that flows like water and air; but electricity is not like water and air except in this one fact, that it flows. Franklin said that this electric fluid is found in all bodies, each body having its natural quantity of the electric fluid. If by friction a body gets more than its natural quantity, then the body owing to this extra amount is charged with positive electricity. If a body has less than its amount of fluid, then the body is charged negatively. This explains the fact that when rubber and fur are rubbed together the fur is electrified positively at the same time that the rubber is charged negatively. Thus, according to Franklin's theory, positive electricity means an excess of the electric fluid, and negative electricity means a deficit of the electric fluid. We can think of electrified bodies on Franklin's theory as something like two tanks of air. If air is pumped from the first tank into the second tank, then the first tank has less than its normal amount of air, or is like a body charged negatively. The second tank has more than its normal amount of air, or is like a body charged positively. Connect the two tanks with a pipe, and air will flow from the second tank to the first tank. Similarly electricity flows from the positively charged to the negatively charged body. But this is only an analogy, for electricity is not air.



Here is one way of proving the law that "like" repel and "unlike" attract each other. The suspended rod (A) which is negatively charged is drawing away from another negatively charged rod, but is dipping down (B) toward a positively charged rod.

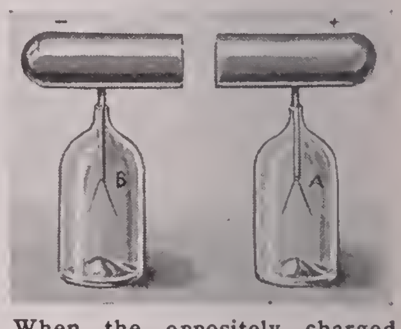
Franklin's fluid theory was the best theory we had for over a hundred years, indeed until Prof. J. J. Thomson discovered and measured the "electron"—and this was as recently as the year 1897. All electrical students of the present day believe in the electron theory of electricity. And what is this latest and best theory of electricity?

The Electron Theory

We will try to tell it in simple terms. You know that substances are made up of minute bodies called atoms (*see* Atoms and Electrons). Thus we have hydrogen atoms, oxygen atoms, and iron atoms—indeed as many kinds of atoms as we have elementary substances in chemistry, which makes nearly 90 kinds of atoms. We know now that every atom is made up of equal quantities of positive and negative electricity. The central part of the atom is called the nucleus, and is *positive* electricity. Around the positive nucleus are one or more minute particles of *negative* electricity, called "electrons." These electrons are all alike, and by certain methods can be separated and moved from one body to another body. When an electron—that is, negative electricity—is taken away from an atom, this leaves more positive than negative electricity on the atom—that is, the atom is charged positively. There is, of course, another body that gains an extra electron at the same time, and thus has more negative than positive electricity—that is, becomes charged negatively. The electrons weigh 2,000 times less than the smallest atom, and the atom is so small that it would take more than 10,000,000 of them alongside one another to extend an inch. Electrons can thus flow through solids, passing in some way from atom to atom. The positive electric particles do not flow easily, like the negative electrons, and it may be that the only flow of electricity is that of the negative electrons. The electron theory is thus more than a theory of electricity, for it tells us that *all matter is made up of electricity*. This discovery of electrons and of their activities is one of the wonders of science, and is leading to many more discoveries and useful applications. (*See* Audion.)

You may have noticed that the Franklin "fluid theory" claims that the electric current is a flow of positive electricity from positive to negative, while this newer "electron theory" says that the current is a flow of negative electricity from negative to positive. The effects produced by the current would be the same, however, under either theory, for the reversal in the direction of flow counter-balances the reversal in the kind of electricity. Therefore, since the Franklin theory has been made the basis of many practical rules in using electricity, its viewpoint is still generally used.

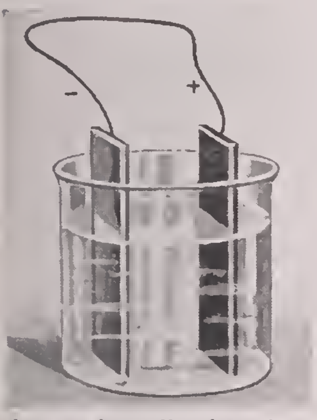
Holtz, Wimshurst, and others have designed machines for producing electrostatic electricity. These consist of rotating disks of glass or hard rubber with suitable metal collectors and other parts. With such machines, it is possible to get long brilliant sparks, when the elecrons jump through and across the air gap between the discharge balls. Such electric spark discharges are of course momentary flows or currents of electricity, but even in the largest static electric machines, the currents are small and not constant and continuous. To get large and continuous electric currents we use batteries and dynamos.



When the oppositely charged bodies on top are brought together, the gold-leaves below collapse, showing the charges to have been neutralized.

How Current Electricity is Produced

The first man to get a continuous flow of electricity or an electric current was Alexander Volta, an Italian professor (1745–1827), and his device is still called the "voltaic cell." A simple voltaic cell or "primary cell" consists of a plate of zinc and a plate of copper, dipped into dilute sulphuric acid. When the copper and the zinc are joined on the outside by a wire, an electric current flows through this wire from the copper to the zinc. This is according to the Franklin theory, and the current is regarded as "positive." The acid acts on the zinc plate making zinc sulphate, and bubbles of hydrogen gas collect on the copper plate. It is the chemical action that keeps up the flow of electrons along the connecting wire.



A voltaic cell, the simplest of current producers.

Dry cells, gravity cells, and Leclanché cells are "primary cells" in common use. Primary cells are used principally for small currents, such as needed to ring door-bells, and in telegraph service. The storage cell is a cell with two lead plates dipped in sulphuric acid. When an outside electric current is sent through such a cell, it charges the lead plates, making one a positive plate and the other a negative plate, and then the cell acts like Volta's cell. The storage cell is renewed again and again by sending more external current through it, and hence is often called a "secondary cell." Such cells are used in automobiles to make sparks for exploding the gas in the gas engine. (*See* Storage Battery.)

The iron bar becomes magnetized when a current-bearing wire is wrapped about it.

To get larger electric currents, such as are used in driving motors for street-cars and in factories, and for the electric lighting of our streets and our houses, we use dynamos altogether. In a dynamo, the mechanical power of a steam or gas engine, or of a water wheel, is used to rotate coils in front of magnets, thus changing mechanical power into electrical power. (*See* Dynamo.)

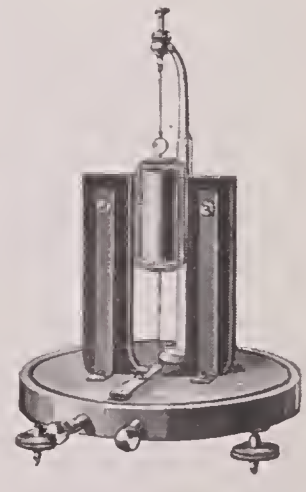
There is a third method in more or less common use for producing electric currents, the method by "thermocouples." A simple thermocouple consists of connected wires of different materials, say one of copper and the other of iron. Heat one of the joints, and an electric current flows in the wire from the copper to the iron across the hot joint. This current is very small, and is not useful to run motors or light lamps. It gives us however a very useful means of measuring the temperature of the joints. If we know the current, then we can know the temperature. Thermocouples are thus very valuable as thermometers.

How Currents are Measured

How do we know that an electric current flows in the wire connecting the plates of a voltaic cell? The electric current of course is invisible. The ordinary gold-leaf electroscope shows no deflection when joined to the plate of the cell, because the electrical pressure or "potential" is so small. In some special cases, it is possible in a darkened room to see tiny sparks by bringing the two wires from a cell together and pulling them quickly apart. We also may get a shock through the hands and body upon pulling apart the wires from a series of cells or from a dynamo. This shock may be so severe as to be dangerous to health and even to life.

To detect and measure an electric current, we observe its various effects. The most important of these is its *magnetic* effect. Bring a magnetic needle near the wire joining the plates of a cell, and you will see that the needle is deflected. The greater the electric current in the wire, the greater is the deflection of the needle. By passing the current through a wire coil of a large number of turns, the deflection of the needle by the current is made greater. An instrument made of coils of wire and a magnetic needle, arranged to measure an electric current by the force of deflection of the magnetic needle, is called a "galvanometer." In some galvanometers, of the D'Arsonval type, the wire coil is made small and is suspended and the magnet is large and fixed; the force is between the electric current in the coil and the fixed magnet, and the coil is deflected. In galvanometers for measuring small electric currents, a very light mirror is fastened to the moving magnet (or moving coil); a beam of light thrown on the mirror is deflected when the magnet moves, and we can thus measure small currents by the deflections of the beam of light. A familiar form of galvanometer is the small "ammeter" on the dashboard of an automobile, which shows how the battery is working.

If an insulated wire carrying an electric current is wrapped in a coil about a small bar of soft iron, the iron becomes a magnet and attracts iron filings, tacks, and other bits of iron. Such an arrangement is called an "electromagnet." By using large iron cores, and many turns of wire with large currents, electromagnets are made to lift tons of iron. When the electric current is stopped the electromagnet loses more or less completely its magnetic attraction. Hence, an electromagnet can also be used to detect an electric current.


This instrument is a delicate current-measurer of the fixed-magnet type.

Everyone knows that when the electric switch in the house is turned on so as to let the electric current flow through an electric lamp, the filament of the lamp is heated to incandescence. The various electric heating devices, such as electric irons, toasters, coffee percolators, and similar apparatus, are also well known. In all these the heat is produced by the passage of the electric current through coils of "high resistance" wire. Heat is produced whenever an electric current passes through any wire, but in larger copper wires the resistance is small, and the heat produced by proper sized currents is small. If the current becomes too large, then a part of the circuit, called a "fuse," melts from the heat produced. The fuse is a short wire of a metal (usually a mixture of lead) which melts easily. All electrical appliances should be protected by proper fuses from excessive heating by the electric currents.

The "hot-wire ammeter" is an instrument frequently used in wireless telegraphy to measure electric currents. It consists of a wire (A B) stretched by a spring (S), with a string (C) connecting the wire to the spindle of a pointer. When a current goes through the wire (A to B), the wire lengthens and the spring draws the cord, so that the pointer (P) indicates the amount of the current through the wire. The hot-wire ammeter is used only for small currents. The heating effect is the same for currents in either direction, and hot-wire ammeters can therefore be used to measure alternating and oscillating currents.

We can also measure currents by their chemical effect (*see* Electrolysis). The amount of substance deposited by electrolysis depends directly upon the amount of the electric current that goes through the solution. It is thus possible to measure the amount of current by weighing the amount of silver or copper deposited by the current. This is a very exact method of measuring an electric current, but it is not a rapid method, and is used mostly to test galvanometers and ammeters.

Direct and Alternating Electric Currents

An electric current which flows continuously in one direction through a conducting wire is called a "direct current," or a continuous current. The electric currents from primary cells, from storage cells, and from certain kinds of dynamos are direct or continuous currents. Dynamos which produce electric currents flowing in the one direction are called direct-current dynamos, or "D.C." machines. An electric motor which runs with an electric current constant in direction is called a "D.C. motor."

Some dynamos produce currents which flow first in one direction and then in an opposite direction, reversing directions, in our ordinary power plants, 60 times a second. Such currents are called alternating currents, and the dynamos producing such currents are alternating-current ("A.C.") dynamos or alternators. An alternating current reversing itself 60 times per second is called a "60-cycle" current. While alternating currents seem to be less simple than direct currents, yet A.C. dynamos, motors, and other machines are mechanically simpler than D.C. machines and require less attention. Alternating currents can also be carried over smaller wires for the same power than direct current. Hence practically all of our large electric power plants today are alternating current plants. (*See* Dynamo.)

Electric Oscillations

When an electric current reverses its direction thousands of times per second or even more, it is an oscillating electric current, or it is said to consist of "electric oscillations." It was a great American scientist, Joseph Henry, who showed that the ordinary spark discharge of a Leyden jar consists of oscillations. You know that when a stretched steel spring is released, it vibrates rapidly backwards and forwards before coming to rest. The electric discharge of a Leyden jar is like the release of a spring, and consists of thousands of electric vibrations, many electric oscillations backwards and forwards, in the short time before the jar is discharged. This can be shown by a series of instantaneous photographs, a sort of moving picture photography, only hundreds of times more rapid than that used in moving pictures. Oscillating electric currents of course have magnetic effects, as do all electric currents, but these currents reversing so rapidly cause effects which are marvelous. They produce electric waves not only in nearby wires, but also in the ether of space, the electric waves of wireless telegraphy. Electric oscillations of the highest frequency are produced by some form of electric discharges, but alternating current dynamos have been built by Alexanderson to give oscillations with 200,000 cycles per second. Such machines are used at the New Brunswick, N. J., wireless station of the United States navy. Only a few years ago electric oscillations had interest for only scientific men, but if the scientific men had not had the interest to discover them without regard to using them, we should not have wireless telegraphy and telephony.

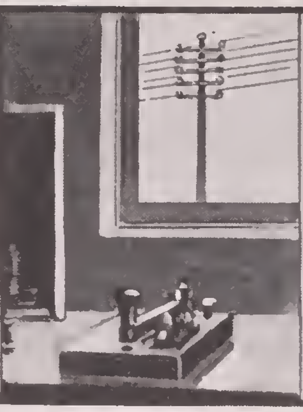
Manifold Uses of Electricity

In this short article we have seen some of the simpler facts about electricity at rest and electricity in motion. It is a subject to which many of the ablest students of the last 200 years have devoted their lives, and their discoveries have been many and marvelous. They have given us the telegraph and the telephone, the electric cable and "wireless," the electric light, the trolley car, the electric automobile, the electric furnace, and a score of other amazing applications of electricity that have transformed modern life. We turn a switch or press an electric button and miracles as great as those dreamed of in the 'Arabian Nights' are performed in our households by servants who never grow tired or ask for a day off. In the twinkling of an eye our rooms are flooded with light. No lamps for the weary housewife and mother to fill; no chimneys for her to clean. The electric iron saves her thousands of steps; she no longer has to walk back and forth between a hot stove and the ironing board. For the preparation of food she has many labor-saving devices at her command, from the small heating coils that just fit around the baby's milk bottle, and the small immersion heaters for use in any liquid container, up to the complete

HOW MAN HAS PUT ELECTRICITY TO WORK

ELECTRIC LIGHT

HEATER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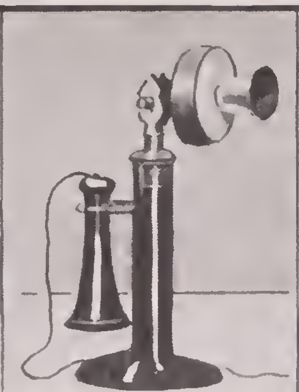
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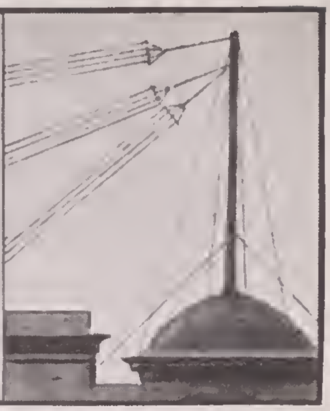
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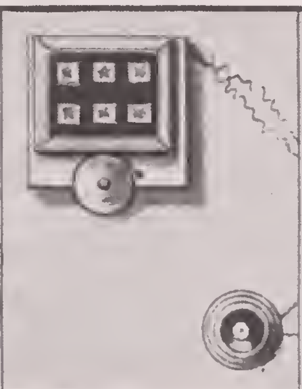
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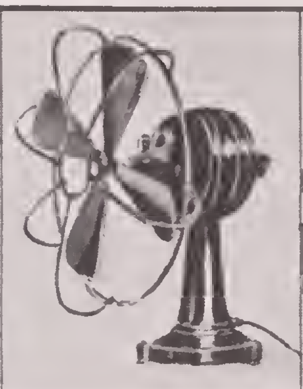
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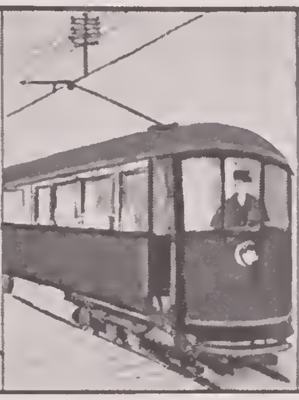
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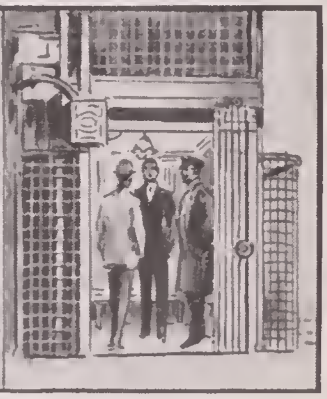
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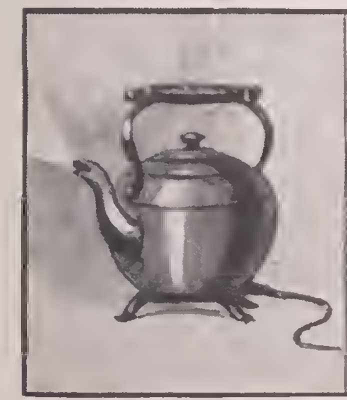
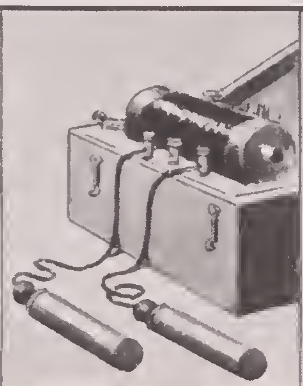

KETTLE

LOCOMOTIVE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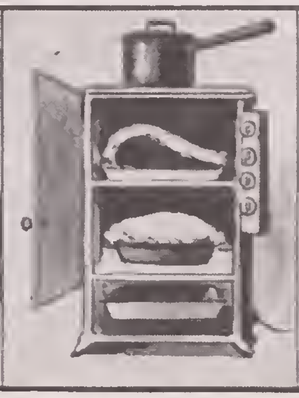
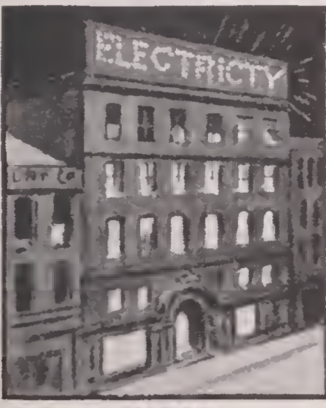

BAKE-OVEN

ELECTRIC CLOCK



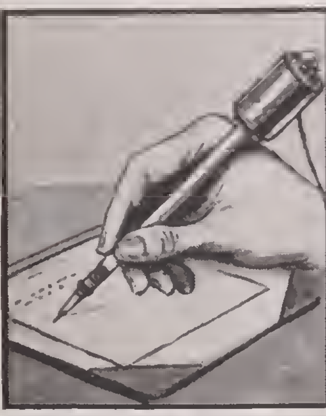
SIGNS

VACUUM CLEANER

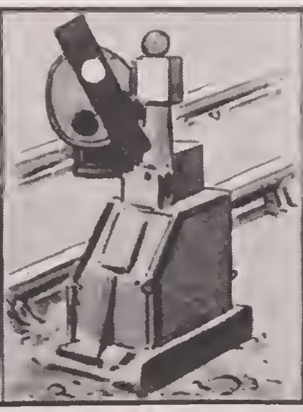
MOTOR-BUS

FLAT-IRON

FLASHLIGHT


ELECTRIC PEN

ELECTRO-PLATER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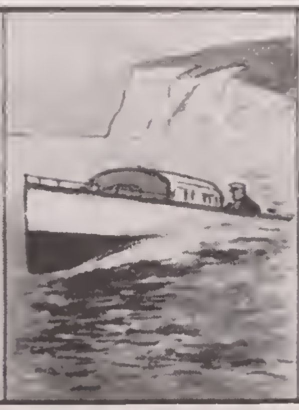
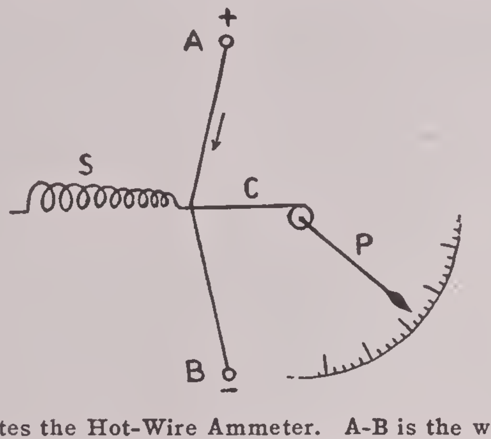

LAUNCH

FORGE BELLOWS

electric range. The housewife in the modern home may sit down at the table with the rest of the family, while the eggs are cooking in an electric egg-cooker on the table or chops are broiling in a chafing dish. At the same time an electric toaster toasts bread as it is needed, and an electric coffee percolator prepares the hot drink.

For kitchen use, there are many styles and sizes of electric ranges. Many of them are equipped with clocks for automatically turning the heat on and off at a fixed time, and automatic heat-regulating devices, so that the housewife does not need to stay at home while the meals are cooking.



This illustrates the Hot-Wire Ammeter. A-B is the wire which heats and lengthens when current runs through it. The spring S then draws the lengthened wire to one side, and the wire C then turns the pointer. The hotter and longer A-B gets, the more the pointer turns.

Other heating devices are the electric heating pad, which takes the place of the hot water bottle or the hot brick to give warmth and comfort to the invalid or to take the chill out of the beds in winter; the electric curling iron and hair dryer, and the electric shaving mug for father's use. Electric systems for heating entire houses have been manufactured, doing away with the nuisance of smoke and ashes, and the work of caring for stoves and furnace. But alas! heating by electricity is still far too expensive in comparison with other fuels for it to be generally adopted. In more general use is the small electric heater for furnishing additional warmth. This is especially useful to warm the bath-room while the baby is taking its bath.

Many power devices as well have been designed to save the time and strength of the housewife and to make it possible to care for homes without the help of so many servants. The electric washing machine, clothes wringer, and mangle greatly lessen the labor of wash-day. The electric vacuum cleaner saves the work of sweeping, shaking rugs, dusting, cleaning curtains and draperies, and cleaning around radiators and difficult corners. The electric sewing machine, the floor scrubber and polisher, and the dish-washing machine are other appliances which belong in this class. As for the electric fan, it has proved as indispensable, during the hot days of summer, in the home as in the office. We even find an electric motor producing artificial refrigeration for the ice box and to cool the air. There are also many farm tools and machines that can be run by electricity, such as milk separators, churns, milking machines, saws, and electric pumps for the farm water system.

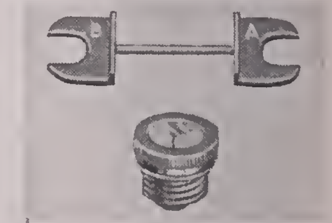
Because so many wonders have been brought to pass by the agency of the electric current, many people seem to think it can be made to do anything whatever. The result has been that many impossible things have been proposed, some through ignorance and some through fraud. Much money has been lost in impossible electrical schemes which could have been saved if the laws of electrical action had been known. Many things not yet dreamed of may be discovered about electricity, and we should support in every way possible the study of electricity. But electricity obeys the great laws of Nature, and one of the great laws of Nature is the conservation of energy. It tells us that work is not created from nothing, only at the expense of other energy. Hence any "get-rich-quick" scheme to get work by electricity without using some source of energy is doomed to failure.

Electricity is measured with relation to the *strength* of current, the *pressure* under which it flows, and the *resistance* which it encounters. The unit of resistance is the *ohm;* it is approximately the resistance offered by 400 feet of ordinary telegraph wire, or more technically by a column of mercury 106.3 centimeters in length and weighing 14.4521 grams.

Current is measured in *amperes.* A current flowing through a wire in which the resistance is one ohm and the pressure one volt is said to have a strength (or volume) of one ampere.

Pressure (or electromotive force) is expressed in *volts.* Electric pressure may be roughly compared to the pressure in a water main or a steam pipe. A volt is the pressure required to force a current of one ampere against a resistance of one ohm.

The *watt* is the unit of power. It is equivalent to $\frac{1}{746}$ of one horse-power—or, in other words, it takes 746 watts to make one horse-power. Because the unit is so small, it is common to measure power in *kilowatts* or thousands of watts. Indeed a professor of physics once defined a watt as about equal to one *cat* power. In electrical terms the watt is one ampere under pressure of one volt. If you multiply the *volts* of pressure by the *amperes* of current, you get the number of *watts* of work the electric stream will perform. One ampere under a pressure of one hundred volts is thus the equivalent in working power of one hundred amperes under a pressure of one volt. All of these units are named after men who have been prominent in the history of the science.



Two types of fuses are shown here. The top one consists of an easily melted wire inserted in the circuit which brings electricity into a house or factory. If the current gets too strong the wire melts and cuts it off before it has done any damage. The lower fuse consists of a similar wire enclosed in a "plug cap," protected by a mica face. This is the kind usually employed in house lighting circuits.

The Men who Discovered Electricity's Secrets

From the Wise Old Greek who Wondered about the Jumping Leaves to the Men who Discovered the Wireless—Some Famous Names in the History of Electricity

WHEN Thales of Miletus, one of the Seven Wise Men of Greece (about 600 B.C.) noted that amber, jet, and a few other substances had the power when rubbed of drawing to themselves bits of leaves, straw, or feathers, he made the first discovery of electricity. But Thales, who was the father of Greek philosophy, and who even in that remote day knew enough astronomy to predict an eclipse of the sun, seems to have felt that this observation was of little importance. Perhaps he amused the children of his neighborhood by rubbing some amber trinket on his cloak and making a dry blade of grass dance beneath its strange attraction; that was all.

OTTO VON GUERICKE
Inventor of the First Electric Machine

Certainly none of the ancients suspected the true nature of electricity, nor did they connect the queer properties of amber with the flashing lightning. Pliny the Elder, a Roman who wrote in the year 70 A.D. a famous 'Natural History', tells of experiments similar to those of Thales, and also of painful "shocks" felt by persons who touched the curious torpedo-fish. Yet it did not occur to him that both these phenomena were due to the same cause.

Indeed, such scattered and useless information continued to be the rule until about the beginning of the 17th century in England. At that time Dr. William Gilbert (1540–1603), physician to Queen Elizabeth, wrote a great book called '*De Magnete*', telling of many experiments with lodestones and the magnetic compass. He showed that the attraction of amber, jet, glass, sealing wax, quartz, sulphur, and certain precious stones was entirely different from that of the magnet. This new force Dr. Gilbert called "electric," from the Greek name for amber (*elektron*). He was thus the first to give us the *name* for electricity. This was in 1600, and still Gilbert little dreamed that the feeble attractions which he studied and described were to become the great industrial power of our modern world.

The First Electric Machine Invented

Otto von Guericke (1602–1686), mayor of Magdeburg, Germany, became deeply interested in the discoveries of Galileo and Torricelli on the weight of the atmosphere. In the course of his experiments he invented the air-pump and in the presence of Emperor Ferdinand III made a famous demonstration of atmospheric pressure with the "Magdeburg hemispheres." These were two hollow metal hemispheres which he constructed, each with a handle, and fitted together with an air-tight joint so as to make a hollow sphere. When the air had been exhausted from the interior, 16 horses, it is said, were unable to pull the hemispheres apart.

In the history of electricity von Guericke earned a place by his invention of the first electric machine, a sulphur ball mounted on a shaft and rotated by a handle while rubbed by the operator's hand, thus producing sparks. He also discovered that electrified objects coming into contact with non-electrified substances communicate some of their electricity to the latter.

We remember the name of Robert Boyle (1627–1691) chiefly as the discoverer of "Boyle's law" in physics (*see* Gas) and the man who defined an element as a substance incapable of decomposition and who helped the young science of chemistry to escape from the trammels of alchemy. Here he is important for his discovery that electrified bodies in a vacuum can still exercise their power of attraction.

About 30 years after Dr. Boyle's time lived another Englishman, Stephen Gray (1696–1736), of whom we know little except that he was educated at one of the great English charity schools. He found in 1720 that electricity could be excited by the friction of hair, wool, silk, and paper, and that some substances are conductors of electricity and others are not. His great experiment was a startling forerunner of the invention of the telegraph. He suspended a thread 886 feet long by loops of silk and sent over it a current of electricity produced by rubbing glass.

Discovery of the Electric "Twins"

In France, C. F. de C. du Fay (1699–1739) repeated Gray's experiments and found that glass was a good insulator for the cord used in transmitting electricity. When he touched an electrified object he became charged with electricity, emitting a crackling spark when touched by another person. In other words, he had found that the human body itself is a conductor of electricity.

Du Fay's great discovery, however, was that electricity is of two kinds, one of which may be produced by rubbing glass with silk, and which he therefore called "vitreous" or glassy electricity; while the other, which he called "resinous electricity," may be produced by rubbing resin, amber, and some other substances with flannel. He found that objects charged with the same kind of electricity repel each other; the ends of one's hair, for instance, fly apart after being combed with a rubber comb. Objects charged with different kinds of electricity attract each other, as the electrified hair is attracted by the comb. As we say today, objects charged with "positive" electricity repel each other, but attract objects charged with "negative" electricity. Negatives in turn repel each other but attract positives. Du Fay's "vitreous" electricity was of the positive kind.

Men who Bottled Electricity

Up to this point in our story, experimenters in electricity were like the man in the 'Arabian Nights' who has learned to rub the jewel that compels the Slave of the Ring to appear, but who has not learned the spell that binds him to stay. If the jinn could be bottled up—if electricity could be accumulated and used at will—how much more could be learned about this mysterious force! Electricity leaks through metal like water through a sieve, but glass offers great resistance to its passage; so why not try to store electricity by charging water inside of a glass bottle?

This idea occurred at about the same time (1745) to several men—a German clergyman, E. G. von Kleist, and two professors in the University of Leyden, Cunaeus and Van Musschenbroek (1692–1761); and some very badly frightened experimenters received the shocks from the first "Leyden jar," by touching the iron rod by means of which the water had been charged, while holding the jar with the other hand. Sir William Watson (1715–1787) and Dr. John Bevis (1695–1771) developed the Leyden jar by doing away with the water and coating the glass inside and out with tinfoil.

Watson demonstrated that gunpowder could be exploded and alcohol set afire by a spark from a Leyden jar. But his most important experiment was one in which he observed that electricity traveled in what seemed an instantaneous way to the end of a wire two miles long.

Franklin Experiments with Lightning

At this point appears the first American name in the history of electricity, and a great one it is—Benjamin Franklin (1706–1790), the story of whose life is told elsewhere.

Until 1752 electricity meant a property produced in certain terrestrial substances by friction. The similarity between the electric spark and lightning, and between thunder and the crackling sound of the electric discharge had been noticed more than once. But any theory as to the identity of the two sets of phenomena was pure conjecture, for how could the wild and furious lightning be caught and caged and compared with the jinn that had been evoked from amber and glass?

Franklin's observation that electricity is readily discharged from and collected by points was an important element in the famous demonstration which he devised, and the recently invented Leyden jar came in most usefully as a means of collecting the discharged lightning. After waiting vainly for the construction of a spire by which he hoped to lead lightning to earth, he decided to collect it by means of a kite during a thunderstorm. His kite was silk-covered, so that it might stand rain and wind. A sharp-pointed wire was fixed to the frame, rising a foot or more above the top. To prevent the electricity from escaping through the hand and body of the person holding the kite, a piece of silk ribbon was tied to the lower end of the kite-string. At the junction of the twine and the silk was suspended a door key.

On that memorable day in June 1752, Franklin raised his kite in a gathering thunderstorm and stepped back into a doorway lest the rain should wet the silk ribbon by which he held the kite and so convert it into a conductor of electricity. At last the ends of the loose filaments on the twine where it was knotted to the silk stood out in every direction, showing that the kite string was electrically charged. When Franklin brought his knuckle near the key, a spark flew out. Soon the string conducted downward such amounts of electricity that Franklin was able to charge a Leyden jar with it; and the effects obtained from this Leyden jar were in all respects identical with those from a jar charged with electricity produced by friction. In other words, Franklin had *proved* the identity of lightning and electricity.

This experiment suggested to him the idea of the lightning rod (*see* Lightning). He was later able to demonstrate that some clouds are charged with positive and some with negative electricity. His "single-fluid" theory is explained in the preceding article.

After Franklin's kite experiment, many workers, of whom we can mention only a few, added, bit by bit, to the theory and practical knowledge of electricity. John Canton (1718–1772), an English schoolmaster, discovered electrostatic induction, by which an electrified body produces an electric charge in another insulated body. A German professor, Francis Aepinus (1724–1802), extended Franklin's theory of electricity to account for magnetism. Other experimenters proved that the "shocks" given by such animals as the torpedo-fish are shocks of electricity manufactured in the animals' bodies.

The Men who First Measured Electricity

The brilliant, wealthy, and eccentric Englishman, Henry Cavendish (1731–1810), grandson of the second Duke of Devonshire, lived only for scientific research and to avoid contact with his fellow human beings. He refused to meet strangers; he met the nephew, whom he made his principal heir, for a few minutes once a year; his female servants were bidden, on pain of discharge, to keep out of his sight. This morbid dread of human contact seems to have found further expression in complete indifference to the publication of his researches, some of which remained unknown for many years after his death. Consequently, he received credit for some of his discoveries only after they had been rediscovered and identified with the names of other scientists. The electrical investigations of Cavendish were distinguished by exact quantitative work. He discovered the law that the force of electric attraction between bodies varies inversely as the square of the distance that separates them. This principle, worked out a little later by the

GREAT STEPS UP THE LADDER OF SCIENCE

What thrilling moments there have been in the history of electrical science! Here we see a few of them depicted. At the top (1) two men of ancient Rome are experimenting with the action of a bit of lodestone on a floating needle. Next (2) Dr. Gilbert is just realizing that he has discovered a "new force." Then (3) that queer genius Cavendish is shown in his secret laboratory. Franklin and his kite (4) illustrates a story known to every schoolboy. And as a sequel to Franklin's work, we see Samuel Morse (5) listening to the tick of the first telegraph instrument. Below (6) Michael Faraday is explaining the principles which make the dynamo possible. And next to him (7) Roentgen is examining the first X-ray photograph. Dr. Bell (8) is listening to the first faint sounds coming over the wire of the early telephone, while Edison (9) is listening to the first phonograph under the electric light he invented. Finally (10) we see Marconi listening to a message conveyed across space by the Hertzean waves which make wireless telegraphy possible. By thinking over these moments we realize how important they were to civilization!

French engineer, C. A. Coulomb (1736–1806), is known as Coulomb's law. Cavendish also anticipated by nearly 50 years the discovery by the German G. S. Ohm (1787–1854) of the fundamental law of electric flow, known as Ohm's law—that the current varies directly as the electromotive force and inversely as the resistance.

A Scientific Battle over a Dead Frog

In 1790 Luigi Galvani (1737–1798), professor of anatomy in the University of Bologna, in the course of some experiments on "animal electricity," hung a dead frog over an iron balcony railing by a copper hook through the frog's back. The creature's body was at once convulsed by lively twitchings. Galvani's conclusion was that the frog was a kind of naturally charged Leyden jar, with negative electricity on the exterior surface of the muscles which discharged through the iron railing, and positive electricity along the nerves of the interior which discharged through the copper hook.

Galvani's published experiments and deductions aroused great interest and much controversy. Alessandro Volta (1745–1827), professor of physics in the University of Pavia and already known for his electrical researches and inventions, maintained that the primary cause of the electrical activity was the contact of the two metals, and that the body of the frog merely acted as a conductor completing the circuit. In the course of his experiments he constructed the first voltaic pile.

Volta proved that a zinc and a copper plate in contact have a slight difference in electric charge, one being positive and the other negative. He showed that if several pairs of such plates are separated by cloths moistened with acid or salt solution, and if the first pair is joined to the last pair by a wire, a steady electric current is produced. It was but a step from this "voltaic pile" to the "voltaic cell," in which an electric current is produced by a pair of dissimilar metal plates connected by a wire and dipped in an acid or salt solution; and then only another step to the "crown of cups," as Volta in 1800 called his first "voltaic battery."

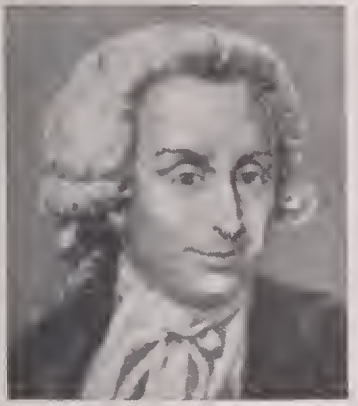
The voltaic pile, cell, and battery are sometimes called "galvanic" in honor of the man whose dead frog started the inquiry, and the current they generate was long known as "galvanism." Galvani is also remembered in the "galvanometer," the instrument that measures electric current, and in "galvanized" iron, which is iron coated with zinc to prevent it from rusting. This coating was formerly applied by "galvanic" or electrolytic methods, though it is now more commonly given by dipping the iron in a bath of molten zinc.

Hitherto we have dealt, apart from lightning, only with electricity produced by friction. Now we have electricity produced in an entirely new way. "The voltaic cell," said Sir Humphry Davy, "was an

IF HE COULD HAVE KNOWN!

Indifferent to his wealth and social position, Henry Cavendish lived only for science. So careless was he of fame that he never announced many of his discoveries; yet they were among the most important in electrical science. One of them was the discovery of the law for measuring electrical attraction. Would he have been so indifferent, if he had known the great things that the future held?

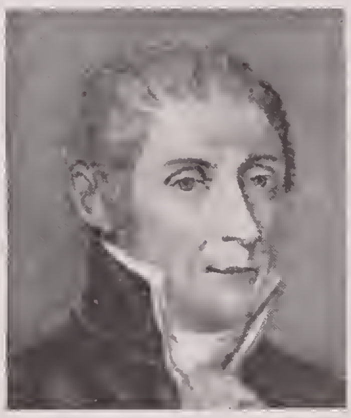
alarm bell to experimenters in every part of Europe." It linked up electrical and chemical action in a way which, though not explained until much later, at once led to brilliant discoveries in chemistry. William Nicholson (1753–1815) in 1800 decomposed water by the voltaic current into oxygen and hydrogen; and Sir Humphry Davy (1778–1829) a little later discovered the elements potassium and sodium by electrolyzing crude potash and soda. Later, about 1809, Davy demonstrated the principle of the arc light.


GALVANI
Who Learned about Electricity from a Dead Frog.

But even with these great achievements to point the way, the "natural philosophers" of the day were still so far from appreciating the future of electricity that the author of a history of "Galvanism," published in 1820, complacently remarks that the new force appears to have reached the limits of its development. Curiously enough, almost every year thereafter was destined to be called the "wonder year" of electricity.

Men who Linked the Magnet with Electricity

A relation between electricity and magnetism had long been suspected, but facts to put the relation on a definite basis had been lacking. In 1820 Hans Christian Oersted, professor of natural philosophy in the University of Copenhagen, announced his discovery of the deflection of a magnetic needle by an electric current. Suspended above a horizontal wire carrying a north-to-south current, a magnet's north end turns westward; suspended below, eastward; suspended on the east side, the north end rises; on the west, it dips.


VOLTA
First Producer of Current Electricity.

OERSTED
A Genius of the Magnetic Needle.

Other investigators were apparently quicker than Oersted himself to appreciate the immense significance of his discovery and to follow it up. A little later in the same year the French academicians A. M. Ampère (1775-1836) and D. F. Arago (1786–1853) announced the fundamental laws of the new field of electrical science known as "electrodynamics," which was to give the world in later years the electric motor, the telephone, the telegraph, and so many other useful and marvelous inventions.

A few years later an Englishman, William Sturgeon, constructed an electromagnet, which was later improved by the great American physicist Joseph Henry (1799–1878) so as to make it available for the electro-magnetic telegraph. In principle Henry invented the telegraph, though it was left for another American, S. F. B. Morse, to work it out. Henry also anticipated some of Faraday's work on the production of induced currents.

FARADAY
Genius of Electro-Magnetic Research.

Michael Faraday (1791–1867), the blackmith's son who became one of the greatest figures in the history of electrical progress, has been called "the Shakespeare of research" because of his power of imagination, which enabled him to penetrate so unerringly into the secrets of Nature. Although his electrical researches overshadow his chemical work, he was, like his master, Sir Humphry Davy, a chemist by profession, and approached electricity from the side of chemistry (*see* Faraday, Michael).

Faraday's enthusiasm carried him joyfully forward over the untrodden paths of electromagnetic research for 34 years. In 1831 he discovered the principle of the induction coil (*see* Transformer) and of the electric dynamo (*see* Dynamo), which, perfected between 1848 and 1880, has given us electric light, the electric street-car, and so many other wonderful applications of electric power. He demonstrated that "electricity, whatever may be its source, is identical in its nature."

MAXWELL
Father of the New Wave Theory.

While Faraday's brilliant discoveries were being given to the world, William Thomson, who later became Lord Kelvin (1824–1907), began his profound investigations into electrical theory which lasted into the 20th century. He not only brought precision and order into every department of electrical science, but also linked firmly the fundamental principles of that science with those of chemistry and physics. He was foremost in developing the knowledge required for laying submarine cables and in the invention of the practical appliances for those cables (*see* Cables, Submarine).

HERTZ
Forerunner of Marconi in Wireless Telegraphy.

James Clerk Maxwell (1831–1879) was known as a genius in boyhood and as one of the foremost physicists of his day from the age of 24. He rejected the idea that electricity exerted a "magic pull" through empty space. His powerful mathematical mind undertook to explain electric and magnetic phenomena as due to motion and stress in a material medium. Electric stresses and strains, according to his theory, produce wave motion in the all-pervading ether and he was thus led on to investigations which pointed the way for wireless telegraphy and telephony. (*See* Ether; Wireless Telegraph and Telephone.)

Maxwell showed that electric phenomena display mathematical relations corresponding to the phenomena of light, from which he inferred that electric disturbances produce waves in the ether moving at the rate of light and heat waves, 186,000 miles a second; and that light, heat, and electric waves are, therefore, much the same thing at bottom. All this while, be it remembered, no one had ever observed the production of ether waves by electricity. The mathematical proof of the existence of these waves, and the subsequent verification, is one of the most amazing scientific achievements of history.

A MODERN GIANT IN ELECTRICAL WORK

William Thomson, who became Lord Kelvin, did tremendously valuable work until his death in 1907. He made notable achievements as an inventor of practical devices, particularly in submarine telegraphy, and was a powerful theoretical thinker as well. His work in pointing out the relations of chemistry and electricity will always be remembered.

The German who Found the Waves

Heinrich Rudolph Hertz (1857–1894), professor of physics in Karlsruhe, Germany, becoming interested in Maxwell's theories, succeeded in producing electromagnetic waves and was able to show that, like light, they are transverse and can be reflected, refracted, and polarized. Thus he showed that the ether is an insulator and a magnetic medium. Thus, too, he provided the basis for wireless telegraphy, which makes use of the "Hertzian waves" named in his honor.

The Italian inventor Guglielmo Marconi (1875– was the first to devise a practicable system for actual telegraphy by means of these waves.

SIR J. J. THOMSON
Father of the "Electron Theory."

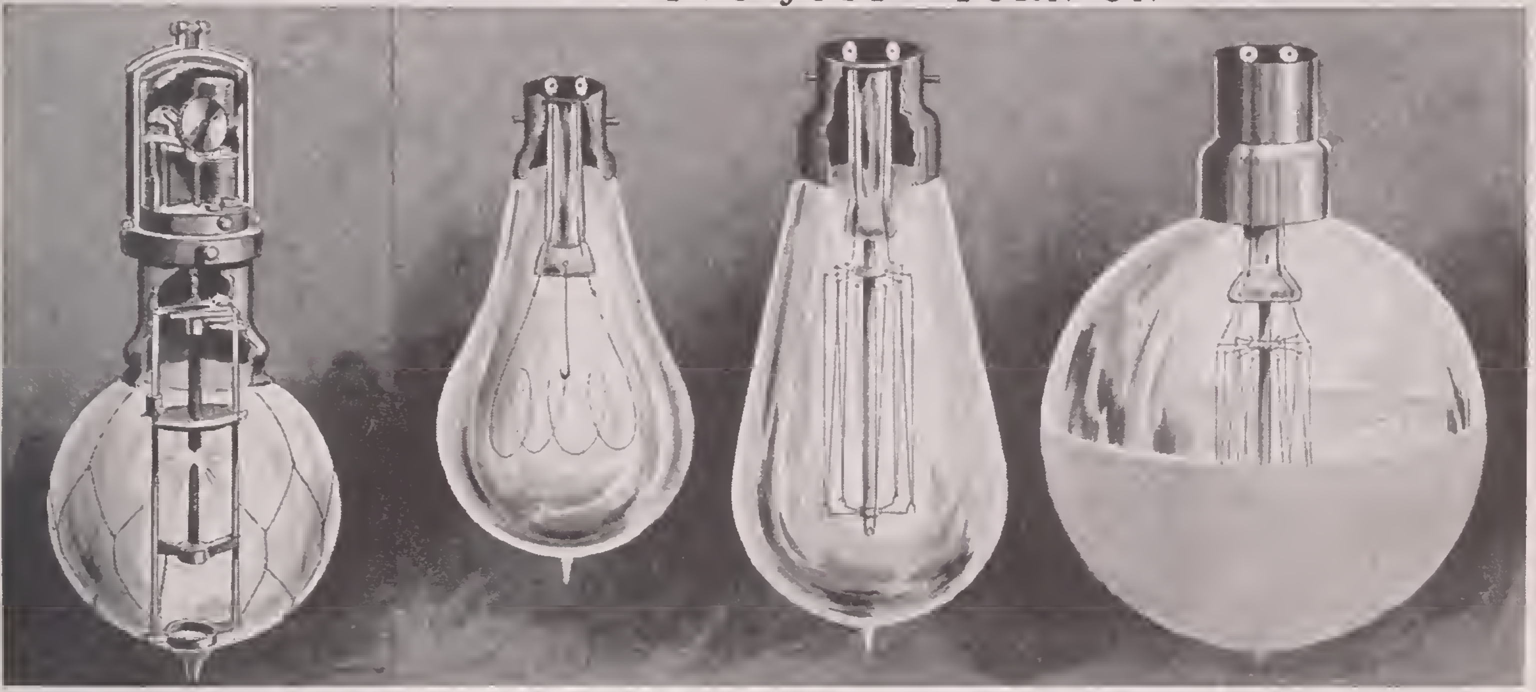
Many men have contributed to the upbuilding of the electron theory, described in the preceding article. Faraday's theories contained a hint of it; Clerk Maxwell had used the phrase, "a molecule of electricity"; Johnstone Stoney called the (as yet) undiscovered ultimate unit of electricity an "electron." It was Sir J. J. Thomson (1856–   ), professor of experimental physics at the University of Cambridge, England, who measured the mass and determined the electric charge of the particles in cathode rays (*see* X-Rays) and identified them with the ultimate particles of electricity and matter now known as electrons.

In making practical applications of electrical science, some men have stood out so prominently that they are called "wizards." Thus, Alexander Graham Bell, who invented the telephone; Thomas Alva Edison, who invented the incandescent lamp; Nikola Tesla, who devised the alternating current induction electric motor; and Wilhelm Roentgen, the discoverer of X-rays, are men known everywhere for their great and marvelous inventions.

There are many others, whose names are less widely known, who have been "wizards" in the magical things which they have accomplished with electricity. The men who invented the electrical street-car system, those who perfected wireless telephony, the designers and builders of the great turbo-dynamos, the electrochemists who have applied electricity to chemical uses—these are but a few of the mighty host of diligent workers who, coming after the great discoverers, have given gifts of untold value to the world.

ELECTRIC LIGHTING. Did you ever stop to think of the magic of being able to press the button of a switch and thus turn on a flood of light in a room? Less than 60 years ago the facts of the common electric lighting of our homes would have sounded like a fairy tale. We are so accustomed to this wonderful gift of science that we can hardly believe that the electric lighting of homes dates only from about 1880, when Thomas A. Edison made the first practical incandescent lamps.

THE LIGHTS YOU JUST "TURN ON"



The first use of electricity for lighting was in the arc lamp, a powerful illuminator but unsuitable for homes. One form of this is shown at the left. Then came the famous "hairpin in a bottle," Edison's incandescent lamp, which was destined to revolutionize the illumination of the world. From Edison's first lamp, with a carbon filament, inventors progressed to metallic filaments, until now the dazzling "tungsten filament" lamps, shown in two sizes at the right, are the standard electric lights of the world for general use. The last bulb differs from its predecessors by being filled with nitrogen gas, instead of being exhausted of air.

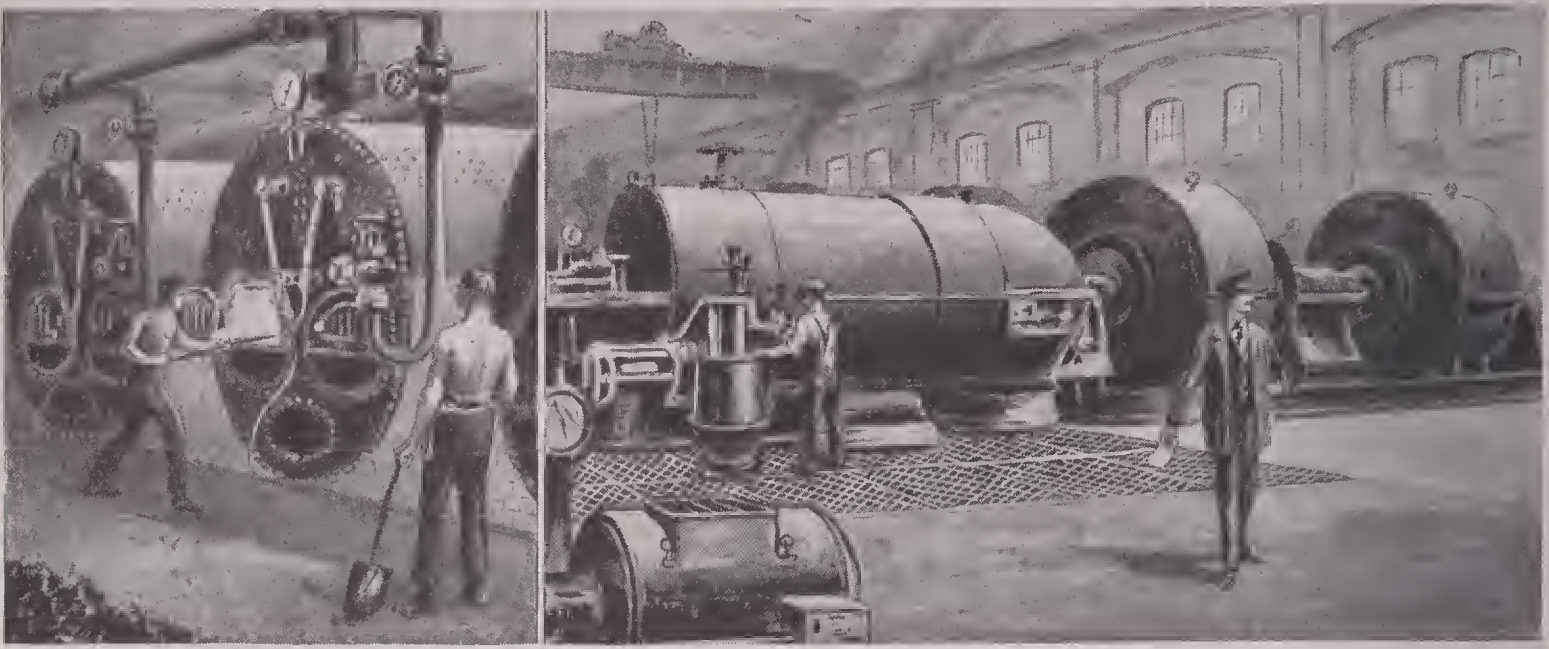
Before Edison's lamp, the only commercial electric lighting was by electric arc lamps. In the electric arc lamp, there are two carbon rods, with their ends nearly meeting. The electric current is carried along one of the carbon rods and then jumps across the narrow space to the other carbon rod, and in doing so, heats the ends of the rods, making a bluish "arc" of carbon vapor through which the current flows. The ends of the carbon rods become white hot, and give off a brilliant light. The electric arc lamp was discovered by Sir Humphry Davy as long ago as 1801, but it was not until the dynamo had been perfected as a generator of electric currents that electric arc lighting became generally possible. The electric arc lamp requires some mechanism to keep the two carbons at the proper distance apart and many such devices have been invented. In 1878, C. F. Brush of Cleveland, Ohio, invented the first efficient arc lamp system, which was used widely for lighting streets and factories. The arc light is the most brilliant of artificial lights. It is the best light for searchlights, for locomotive head lights, and for stereopticons and moving picture projection, but since the invention of the filament lamp, it is being used less for street lighting.

The arc light is not suitable for lighting homes. It cannot be easily used in small lamps, and the carbons are soon burnt up and have to be renewed. It was the need of small electric lamps which could be distributed at convenient places in the home that led Edison and others to invent the incandescent electric lamp. Few of us realize how much thought and work it took to bring this lamp to its present perfection. The lamp consists, as we have it today, of a glass bulb with a loop of fine tungsten filament or wire inside. Connections with this filament are made by a special kind of wire which can be "sealed" through the glass when the glass is hot; when the glass is cooled, there should be no place for air to leak into the bulb, and also no cracking of the glass about the wire. Platinum was long used for these connecting wires, but platinum became so scarce and expensive that new composition wires had to be devised. These connecting wires are joined to the proper parts of the metal base of the lamp, and thus connections can be made in the socket for the electric current. The air is exhausted from the bulb, so that the filament can be raised to a white heat by the electric current without burning up. In some lamps, an inert gas, nitrogen or argon, is used in the bulb. Neither of these gases acts chemically on the filament, and the filament can then be safely raised to a higher temperature and thus give off more light than a filament in a vacuum.

Edison's Long Search

Edison sought long for a good filament. It had to be fine, and yet strong and durable and efficient. Edison found that a certain vegetable substance when charred to carbon and prepared by special processes made a good lamp. This carbon filament lamp made possible electric lighting in our homes. About 1906, improvements in the handling of the rare metals tan-

THE POWER BEHIND THE ELECTRIC LIGHT



Many people would think that the invention of an electric light was enough to start electric lighting, with all its convenience, throughout the world. But the arc lamp was invented by Sir Humphry Davy in 1801, and nothing was done with it until the perfecting of the dynamo, after 1880, made it possible to supply electric current in sufficient quantity for city lighting. The picture above shows a typical electric power station. To the left are the boilers which furnish steam for the steam turbine just to their right. Beyond the turbine are the dynamos which make possible the boon of electric light for all of us.

talum and tungsten made it possible to use fine wires of these metals as filaments. These metals can stand much higher temperatures than carbon, and so take less electric power to give off a candle power of light. The carbon filament lamp, which was best adapted for general service, uses about three "watts" of electric power to produce one "candle power" of light. The tungsten filament lamp is much more efficient. It uses only about one watt of electric power for a candle power of light. That is, we get the same amount of light with a tungsten lamp at one-third of the cost of light from the carbon lamp. The tungsten lamp filled with nitrogen gas in the higher power lamps is still more efficient.

The Power Houses that Furnish the Current

In all these lights there are no wicks to clean, no chimneys to wash. Occasionally one of the tiny filaments breaks and the lamp is replaced with a new one, and in the arc-lamps the carbons must be periodically renewed. Somewhere, perhaps miles away, a power plant or generating station furnishes the current, and wires strung on poles, or insulated and laid in "conduits" underground, bring the current from the power house to the branch wires. The ceaselessly humming dynamos or generators in these plants are turned either by water-power (hydroelectric plants) or by steam furnished by burning coal (steam plants). In the United States alone there are more than 5,500 such electric lighting systems, of which about 1,400 use water-power. Some of the systems are owned by the municipality which they serve, others are operated by private companies under a franchise. Here and there smaller isolated plants furnish light to a single building or group of buildings; and out in the country a convenient water-power or gasoline engine is often used to run a dynamo and storage battery to supply electric light where central stations do not reach. Also by means of small dynamos and storage batteries ships at sea, moving trains, and automobiles are supplied with electric lights of their own.

ELECTRIC MOTOR. If some Rip Van Winkle should awaken after a sleep of 100 years, nothing perhaps would puzzle him more than the electric motor. In machine shops he would see a machine rotating rapidly and with force enough to drive lines of shafting, with pulleys and belting, working tools such as lathes, milling machines and drill presses, and no outside connections for power except two or three small wires. In homes he would see a little motor turning the washing machine and wringer, the vacuum sweeper with its electric motor, and the little motor working the sewing machine. On the street he would observe cars drawn without horses, driven by electric motors attached by gears to the wheels. If he should ask how these motors keep going, he would be told, "They get electricity from the dynamos in the distant power plant by these connecting wires, and the electric current makes the motor go."

Let us look more closely at this modern wonder. It has an outside iron frame, which also serves as a base. This frame is called the "field magnet," and it fits closely about an iron cylinder which can revolve, this revolving cylinder being called "the armature." Sometimes the shaft on which the armature rotates is connected directly to the tool to be driven, as in the case of electric fans for the home, and sometimes there is a pulley and a belt or gears to carry the power to the machine. In smaller motors, the armature rotates at high speed, making generally about 2,000 vibrations per minute.

Coils of insulated wire are wound on both the field magnets and the armature and there are convenient connections so that electric current from outside lines can be sent through the coils, making the field magnet a strong magnet, often with many magnetic poles. In "D.C." motors—that is, in motors run by direct currents (currents constant in direction)—the magnetic poles of the field magnet are generally kept constant while the motor runs. But in "A.C." motors—that is, motors run by electric currents continuously alternating or reversing in direction— the magnetic poles of the field magnets are continuously changing in strength and direction, not haphazard of course, but according to a definite rule for the motor's action.

But what makes the armature move? you ask. This is due to the great discovery made by Hans Christian Oersted (1777-1851) that there is a force acting between a magnet and a wire carrying electric current. Suspend a little coil of wire in which an electric current flows, and bring up a magnet. The coil will turn so as to face one pole of the magnet, the north pole attracting one face of the coil and the south pole attracting the other coil face. Reverse the direction of the current in the coil, and the directions of the attractions are reversed. Now, in the electric motor the armature has coils wound on it which move in the magnetic field of the field magnets according to the same rules as in the simple experiment just described. But in the electric motor there are many coils spaced regularly around the armature, and the force in the coils is greatly magnified by the iron core of the armature.

In "D.C." motors, the electric current is led into the armature coils through a "commutator," a device placed on one end of the shaft so that the directions of the currents in the armature coils are reversed regularly, thus keeping up the rotation of the armature. In "A.C." motors, the magnetic poles of the field are continuously changing in a regular order, and the force on the armature coils thus changes direction continually, corresponding to the changes in direction of the alternating currents in the armature coils.

The electric motor, particularly the "A.C." motor, has made it possible to generate electric currents and use them for power hundreds of miles away. Thus, the water-power in the Sierra mountains, which would otherwise go to waste, can be used to drive dynamos and the currents transmitted 100 miles or more, to run motors for the street-cars of Los Angeles and San Francisco. Perhaps the most striking recent achievement in this field is on the Chicago, Milwaukee & St. Paul Railroad in Montana. On more than 500 miles of this railroad electric locomotives are used, the current for which is generated by water-power.

ELECTROLYSIS. "Electrolysis" means the electric decomposition of a chemical compound, usually a liquid. A current is introduced into the liquid to be decomposed by means of two plates (the electrodes) which form part of an electric circuit. To complete the circuit the current must enter the liquid from one electrode (the anode) and pass through it, leaving by the other electrode (the cathode).

Suppose a current is passed through a solution of copper sulphate. As fast as the copper sulphate partnership is broken up into copper and other substances, the former partners are given marching orders. They are therefore called *ions*, which means "wanderers." "Go to the cathode" is the order to the copper; "go to the anode," to the other substances. In a few minutes we find the cathode has a thin coating of metallic copper. This is the way that table silver and other articles are plated, as well as electrotypes for printing. (*See* Electroplating; Electrotyping.)

A great many industries depend on electrolysis. Copper, zinc, gold, silver, nickel, and other metals are reduced and refined by the process. In aluminum ore (bauxite) the aluminum clings so desperately to its partner elements that, until electrolysis was applied, it was impossible to produce the pure metal on a commercial basis.

Electrolysis at times acts where it is not wanted. Thus gas and water mains are often eaten away by electrolysis produced by stray currents from electric street-car lines.

ELECTRON. The smallest particle of matter, about $\frac{1}{2000}$ the size of the hydrogen atom. The atom was thought to be the limit of smallness until the existence of the electron was proved in 1897 by Sir J. J. Thomson of Cambridge University. (*See* Atoms and Electrons.)

ELECTROPLATING. The thin coating of gold, silver, or nickel that is so much used to ornament or protect table cutlery, watch-cases, bag fittings, stove trimmings, and hundreds of other articles, is applied by what is known as "electroplating." This process is based on the principle that most liquids are decomposed when an electric current is passed through them (*see* Electrolysis).

The article to be plated is cleaned and suspended in a solution of the "salts" of the metal which is to form the coating. It is connected to the negative terminal of a battery, and a bar of the metal to be deposited is connected to the positive terminal. The solution is thus decomposed and the metal it contains is deposited in minute particles on the article.

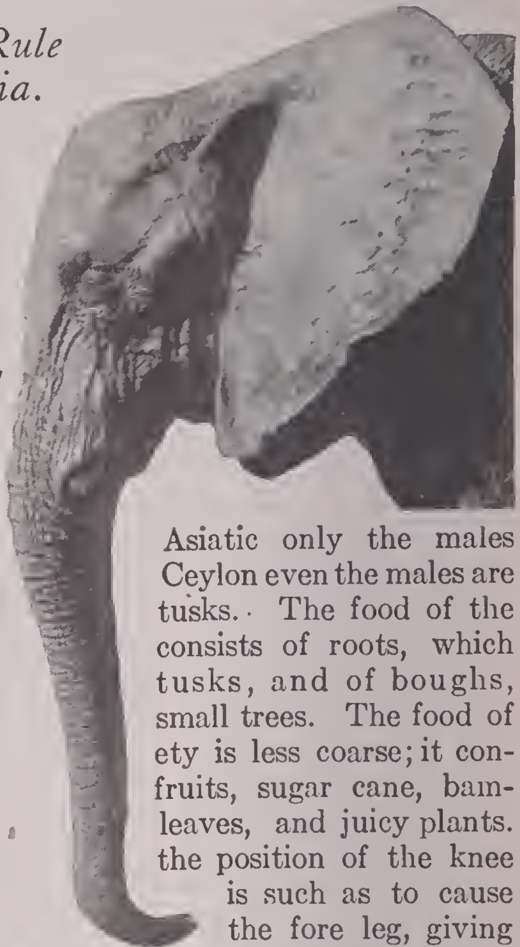
ELECTROTYPING. The principle of electroplating is also used in producing "electrotypes" for printing. By this process copies of type pages, engravings, etc., are made in copper (sometimes nickel), to be used on the printing press.

A wax mold is first made of the type or engraving to be reproduced. After being dusted with graphite to make it a conductor of electricity, this mold is suspended in the bath, usually consisting of a solution of sulphate of copper. The process proceeds as in electroplating, until a thin copper plate is formed over the wax. As soon as this plate is as thick as a stout sheet of paper, it is removed from the bath, separated from the wax mold, and strengthened by a backing of type metal, applied by melting and pouring it on the back of the copper plate.

Books are printed for the most part from electrotype plates, because of their durability; newspapers use stereotyped plates, which can be made much more quickly and cheaply (*see* Stereotyping).

The EMPEROR *of the* JUNGLE

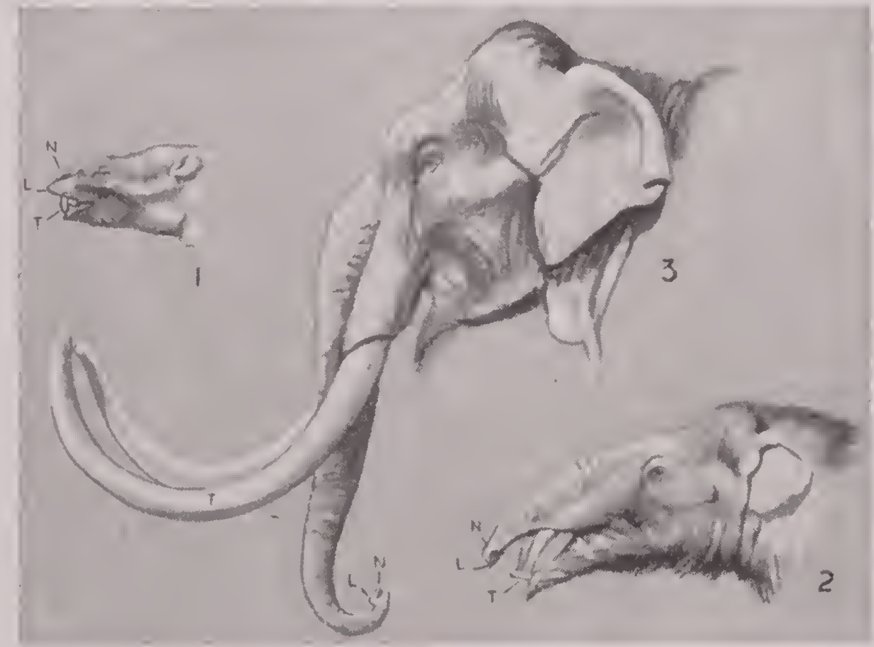
The Lordly Creatures who Rule the Wilds of Africa and Asia. How Their Noses have Turned into Hands and Their Teeth into Ivory Spears—How these Largest of All Beasts are Led around and Taught by Their Mothers—A Giant Eleven Feet High and Still Growing



ELEPHANT. Although fossil remains of various kinds of elephants are found in every zone of the eastern and western continents, the elephant is today represented by only two species, the African and the Asiatic. These are the largest and most powerful of living land animals, and they can usually overcome the attacks of any other inhabitant of the jungle. The elephant in captivity is a patient and faithful servant of man, quick to learn and to obey orders. Far better than the lion, it deserves the title, "King of the Beasts."

The African elephant is the larger, attaining 11 feet in height, while the Asiatic never exceeds 10 feet. The African also has larger ears and larger and coarser teeth. The forehead of the African elephant is convex, that of the Asiatic concave. The trunk of the African appears regularly ridged, as if it were segmented, and the margins of the end form *two* prehensile finger-like lips. The trunk of the Asiatic elephant is smooth and tapering and it has but *one* prehensile lip. In both species the trunk is formed by the union of the nose with the upper lip. The African elephant has four nails on its fore feet and three on its hind feet. The Asiatic has five nails on its fore feet and four on its hind feet. In both forms the toes are inclosed in the skin covering the foot, and they are covered by strong, broad, flat hoofs. In the African species both sexes possess tusks, while in the Asiatic only the males are tusked; in Ceylon even the males are usually without tusks. The food of the African variety consists of roots, which it digs with its tusks, and of boughs, shrubs, and small trees. The food of the Asiatic variety is less coarse; it consists of grains, fruits, sugar cane, bamboo, grasses, leaves, and juicy plants. In both species the position of the knee in the hind leg is such as to cause it to bend like the fore leg, giving the elephant a strange gait compared with the horse.

HOW THE ELEPHANT GOT TUSKS AND TRUNK



The Elephant started several million years ago, with a tapir-shaped head. The drawing (1) is based upon a fossil found in northern Africa. As ages rolled on, the descendants of this creature gradually changed their appearance. The upper lip, still carrying the nostril, grew longer and drooped, while their "eye teeth" commenced to sprout out into tusks and their ears grew larger, until they looked like the lower picture (2). This development went on until it reached its height in the mammoth of Glacial times (3). The mammoth proved a bit over-developed, and the modern elephant is a smaller variety of the type. The letters "N," "L," and "T" indicate the position of "nostrils," "lips," and "tusks" in each case.

The range of the African elephant (*Elephas africanus*) is limited to the interior of the African continent. The Asiatic (*Elephas asiaticus*) is found wild only in the forests of India, Ceylon, Burma, Siam, Cochin China, Sumatra, and the Malay Peninsula.

The habits of the two species are similar. All elephants are social, and herds numbering from 10 to 100 or more, usually led by females, are found in forests in the neighborhood of streams, although they move into open country during the rainy season and may even ascend high mountains. "Rogue" elephants are males which remain permanently separated from the herd.

Elephants frequently migrate with the change of seasons to find better feeding grounds. Like horses, HELPING A "WOUNDED COMRADE"

This well-known statue group of elephants by Carl Akeley stands in the American Museum of Natural History in New York City. It shows two elephants supporting a wounded comrade between them. Elephants are social animals, and it is their habit to stand by each other in danger.

they sleep either standing up or lying down, usually in the middle of the night and in the heat of the day. In captivity they may not lie down for weeks, and individuals have been known to remain on their feet for five years. The elephant is an excellent swimmer and instances are recorded of animals which swam continuously for six hours in water more than 30 feet deep. Elephants cannot leap and never have all four feet off the ground at the same time. They show remarkable speed in running in spite of their ungainly size.

The elephant is timid and inoffensive in its nature, but becomes dangerous when enraged. It expresses its emotions in a definite manner. When about to charge an enemy it utters a shrill, loud "trump," and rolls up its sensitive trunk out of danger. When pleased it squeaks or purrs softly. Rage is expressed by a roar, and suspicion by rapping the trunk on the ground and emitting from it a volume of air with a sound as of crinkling tin.

Naturalists say that the intelligence of the elephant is popularly over-rated. It is, however, very docile and obedient and easily trained, as shown in every circus exhibition. Wild elephants use branches of trees to brush away flies, or lacking foliage, throw grass or spout water over the body, with the same purpose in view, for the practically naked skin is very sensitive. In India and Burma elephants are regularly employed in industries requiring heavy work, in all of which they exercise care and accuracy, two or more animals working together in much the same way as do human beings. They haul logs and lift and carry timbers or boxes containing supplies. An elephant is capable of carrying half a ton over a level country. In hauling heavy loads a regular harness is employed consisting of a leather collar round the neck to which a dragging rope is attached. Elephants are also sometimes hitched to wagons or plows.

For riding, a padded saddle is usually placed on the back of the elephant and on this is bound a box, called a *howdah*, which holds from two to six passengers. The driver or *mahout* sits astride the elephant's neck. In Siam white elephants or albinos are esteemed as sacred.

Elephants seldom breed in captivity. In the wild state one calf, rarely two, is produced at a birth. So great is the mother's care that a baby elephant rarely dies. When on the march mothers and young go in advance, but if an alarm is sounded they immediately fall back and the old males go to the front. The young one returns its mother's affection, and resists to the utmost any indignity offered her.

Since earliest times elephants have been killed for their ivory tusks, and it is said that more than 40,000 African elephants are killed every year for this reason (*see* Ivory).

The largest elephant on record was Jumbo, a giant African elephant once owned by P. T. Barnum, the showman. He was brought to Europe from Egypt when he was only four feet high. For many years Jumbo was the pet of the London Zoölogical Gardens, from which Mr. Barnum bought him for $10,000. Thousands of English children mourned the loss of this friend on whose back they had often ridden, but thousands in America were delighted by him. After only a few years Jumbo was run down and killed by a railway train in Canada in 1885, while being loaded into the circus train. He was then 26 years old, measured 11 feet, 2 inches, and was still growing. His skeleton is mounted in the National Museum at Washington, and his stuffed skin is preserved in the museum of Tufts College, near Boston.

TALES THE WOODMAN TOLD

MOGUL, THE BABY ELEPHANT

THE Little Boy had been away for several days, and when next he came to see the Woodman he was full of excitement.

"I've been to the city," he cried, gleefully; "and we went to the circus! And I saw the most *wonderful* elephants! Do you know anything about elephants?"

The Woodman, who was wondrous wise, smiled and said: "Did I ever tell you about the baby elephant I once helped to capture in India?"

"Were *you* ever in India?" asked the Little Boy, wonderingly.

"Why, yes!" said the Woodman. "And I helped to capture a whole herd of elephants, and one of 'em was a baby that we had to teach to drink milk out of a bottle, because it had lost its mamma."

"Oh, goody, goody!" cried the Little Boy, clapping his hands. "Please tell me the story."

They sat down on a log that the Woodman had been chopping, and he began:

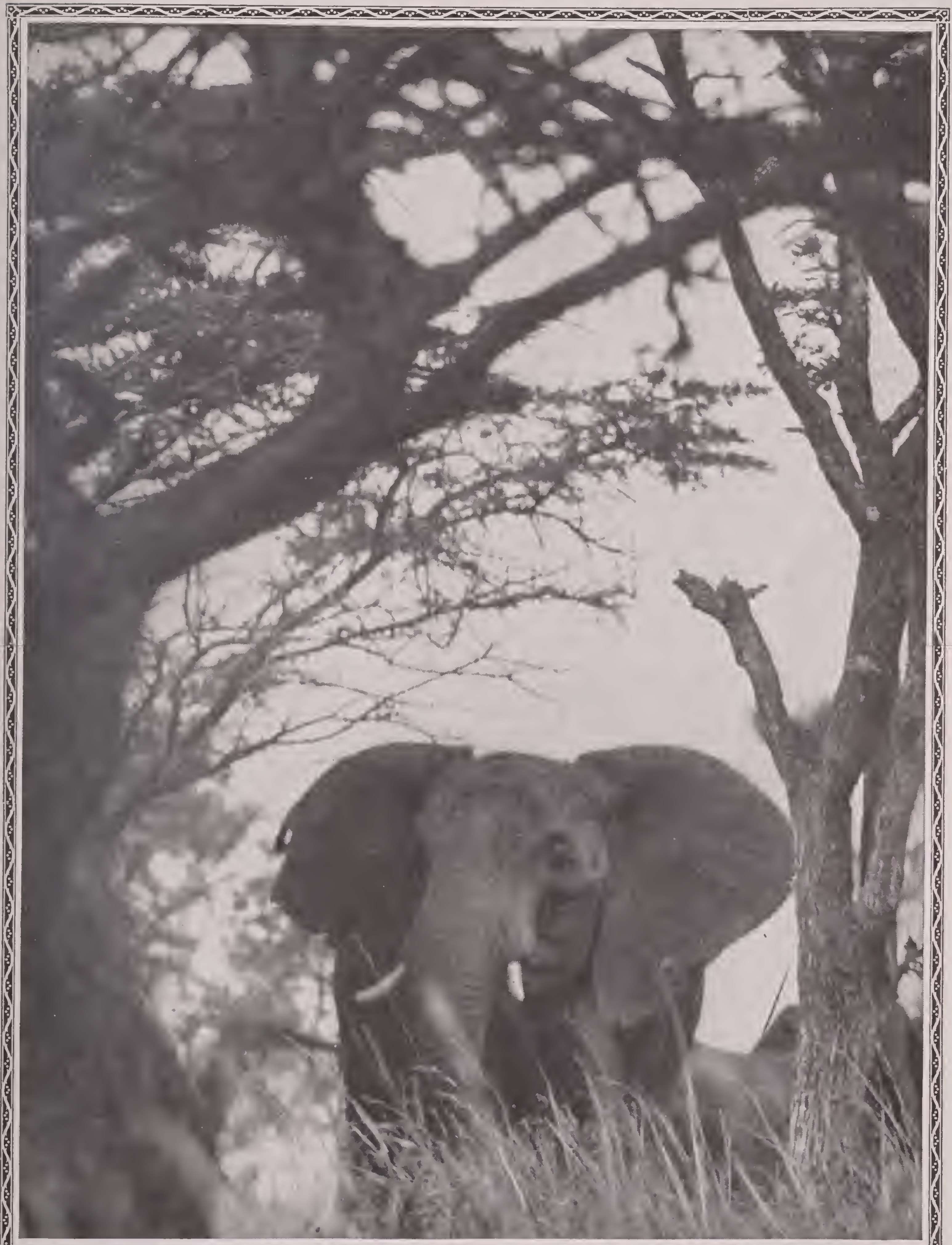
"In the jungle, 'way off in Asia, there are still wild elephants—whole herds of 'em in some places. The government of India won't let you shoot them any more, unless they are dangerous old 'rogue' elephants, or unless they are injuring the crops. Well, Mogul—that was the name we gave this baby elephant when we caught him—was born in the jungle, for his mother was one of a herd of 40 or 50 wild elephants. And he lived in the jungle with the herd until he was about a year old.

"Baby elephants, you know, are awfully funny! At first Mogul was only three feet high, and he weighed about as much as a big St. Bernard dog. He had the funniest little trunk, only as long as a 12-inch ruler. But you never saw such a baby for growing! When he was a year old he weighed half a ton, and he wasn't weaned yet! When he was hungry he would squat in front of his mother, poke his head up between her *front* legs, and suck milk with his mouth—not with his trunk—just like a calf. And his mamma would pet him with her trunk while he nursed.

"During the daytime the elephant herd hid in the thickest part of the forest, and the baby elephants played hide-and-seek about their mothers. When the herd set out to feed at night, the elephants traveled in single file, plucking grass and leaves and twigs of trees with their trunks and stuffing them into their mouths.

"And do you know who led the herd? An old cow

NOW IT'S TIME TO CLIMB A TREE



The person who knows the Elephant language will always start hunting a place of safety, when he sees an Elephant looking like this. This is a mother African Elephant who was hastily snapped by the photographer, just as she had made up her mind that her young son was in danger. The sign of warning is the spreading of the ears accompanied by trumpeting. A second after this picture was taken the Elephant charged, but the bold picture man had dodged safely out of view.

When Mogul was captured he was about a year old and about four feet high.

elephant, the wisest and most experienced of the lot. Most of the time the bull elephants were off by themselves. At the least sign of danger the little baby elephants cuddled right between their mother's legs, while the mothers shuffled along so as not to hurt their babies. And when there was a deep stream to cross, the young elephants that could not swim rode across on their mother's backs.

"That's the way Mogul lived until he was a little over a year old. Then we trapped them—yes, sir; the whole herd, except for one or two that broke through and got away.

"You see, we'd been watching that herd for quite a while; and when the government wanted more elephants to train for work, we were all ready. With about a hundred natives we surrounded the herd, and by fires and shouts kept them from breaking through. This lasted for nearly a week, while we were building a big ring-shaped fence or enclosure called a "keddah." It was half a block across and was made of logs 12 feet long and a foot thick, set close together in the ground. You can guess it had to be strong to hold a herd of elephants! And on each side a wing-fence of stakes was built, making a sort of big funnel down which the elephants could be driven to the narrow entrance to the keddah.

"The first anybody saw of this little Mogul elephant was when the herd had been driven into the keddah and the grown elephants were all tied up, with the aid of the tame ones that help in the work. Then we saw this funny little elephant calf, with a pink and white mark over one eye and ear, charging up and down in the keddah. After you'd once seen him, you'd know him anywhere.

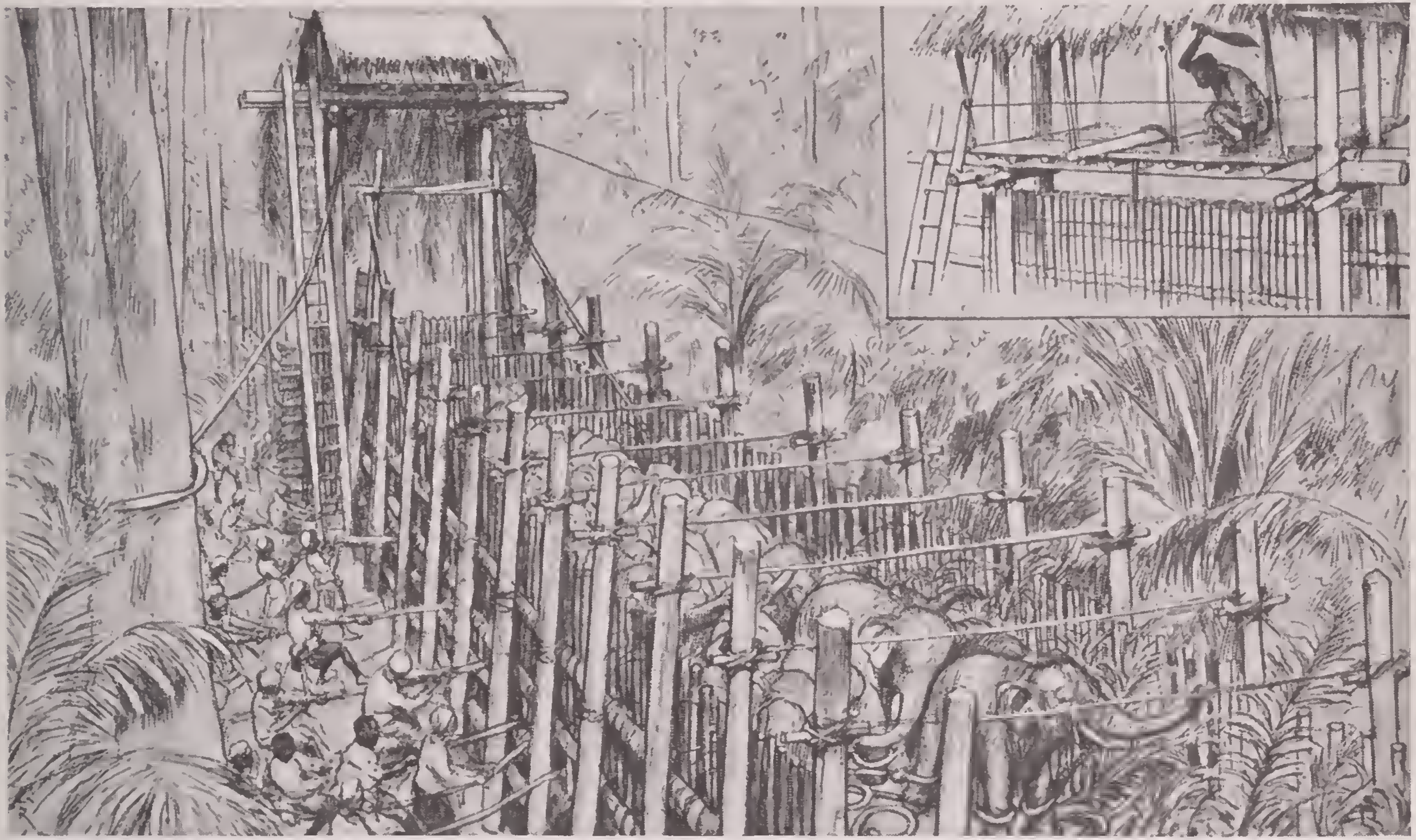
"When the men tried to catch him, Mogul chased them all over the place—with his little tail and trunk up in the air, and his ears flapping! And all the time he was shrieking as hard as he could. My! but he was angry. He was the noisiest animal in the whole herd. But at last the men got him tied fast to a tree, by means of a native's loin-cloth and a jungle vine.

"It was then that Mogul learned to drink out of a bottle. His mother was one of the elephants that got away, and he was too little to live on grown elephant food. So after a bit I tried to quiet him by bringing him some milk to drink.

HOW MOGUL AND HIS RELATIVES WERE CAPTURED

When they decided to capture the wild herd to which Mogul belonged, the men entrusted with the task first built a strong enclosure in which to confine the elephants. Then they started out to drive the herd into the trap. Elephants dislike light at night and noise, and the men knew this. So they gathered about the herd and by shouting, ringing bells, and waving torches, caused the herd to retreat into the enclosure. You see that man up in the tree? He's there to watch the herd and give warning of any that escape.

"CUTTING OUT" ELEPHANTS FROM THE HERD



The big wild elephants in Mogul's herd were captured with the aid of tame elephants. That was years ago. Here we see the modern way of doing the same thing. The herd is driven into this narrow enclosure, and the desired animals are "lassoed" about the legs. At the far end of the enclosure is a heavy door, held up by a thong. As you see in the picture in the upper right-hand corner, a man is posted to cut the thong when the proper elephant has been driven through with pulling and prodding. As may be imagined, a large number of men are needed to handle the lassoes.

"But—would you believe it?—that elephant didn't know how to drink milk! No, sir! Elephants suck up water through two long tubes in their trunks; but little Mogul didn't seem to know what to do with a bowl of milk when we put it before him.

"At last we had to get a bottle and pour the milk into his mouth from that; then he drank it greedily enough. And until he was weaned, some months later, that was the way he always took most of his food. The funniest thing was that all the time he was being fed the little rascal would keep shrieking at the top of his voice. I suppose it was just a bad habit he got into from the time when he was first captured."

Here the Woodman stopped and picked up his ax. But the Little Boy wouldn't let him go back to his work yet.

"Isn't there any more to the story?" he asked eagerly. "Don't you know what became of the baby elephant after that?"

"Well," said the Woodman, "after a time, when he had learned to behave better, his master had a little shed built for him near the stables, and soon he was as friendly as a big dog. Every day he would come up to the kitchen to receive his milk and some bananas. When he saw his master walking in the grounds, he would trot up to him, twist his little trunk around his arm, and coax to be taken to the fruit trees. Sometimes the grass-cutters let him carry home a load of fodder on his back for the other elephants. And once he slipped into the house, helped himself to a basket of oranges on the sideboard, and accidentally swept off all the china and glassware onto the floor!

"The grown elephants that had been trapped with Mogul had long ago been put to work, for it takes only a few weeks to tame wild elephants. At last the time came when Mogul was trained to work. He was fitted with a rope harness and learned to pull and push, and start and stop at the word of command. He had a native driver who sat on Mogul's neck and drummed with his heels and guided the little elephant by touching his ears with an elephant hook. When he talked to Mogul he called out 'Ho! my son,' and Mogul became very fond of his 'mahout', as the driver was called.

"When Mogul became older and his tusks had grown, he was set to piling teak logs in a timber yard. He would go to a log, kneel down, and thrust his stout tusks under the middle of it. Then he would curl his trunk over the log, rise up, carry the log to the proper pile, and place it carefully on top. By and by Mogul learned to do all this without a single word from his mahout. Female elephants are not so useful for such work, for they have no tusks.

"One day Mogul was helping to build a stone wall, and was carrying stones on his tusks and placing them carefully in their places. Presently a stone he was carrying fell off and slipped part way over a cliff. His mahout patted him on the head and said:

"'Ho, my son! Get it, now. Nothing to be afraid of.'

"But Mogul knew that the ground near the cliff's edge was treacherous and he would not go near it. Men had to drop a chain over the stone. Then Mogul braced himself and pulled until the stone was up on the road again. Mogul, you see, had become a wise as well as a strong and faithful elephant. When I left India, soon after that, everybody said that he was one of the best of the younger elephants in all that district."

The Woodman got up, stretched himself, and picked up his ax again. Before he had struck many blows the Little Boy said, wistfully:

"I wish *I* had a little elephant."

AN ELEPHANT'S FOOTBALL

Little elephants are playful and amuse themselves in many ingenious ways. Here is a big round stone which a band of young African elephants were kicking and pushing around when a famous naturalist came upon them in their jungle home.

The Woodman laughed. "You'd better run home now," he said, "and see that your pony gets his supper. An elephant, indeed! Who do you suppose would take care of him?" And he made the chips fly to a merry tune.

The Little Boy started down the lane to the house on the big road where he lived. In the barnyard stood the spotted pony his father had given him on his last birthday, and as he drew near, it whinnied to him. The Little Boy answered, "Whoo-e-e-e!" and ran.

"I guess the Woodman is right, after all," said he. "A pony *is* lots nicer than an elephant."

ELEVATOR. "Floors, please!" The doors click shut, and up we shoot, swiftly and almost noiselessly in that wonder of modern ingenuity, the "lift" or elevator. Suppose we had to climb the stairs to the top of a building 40 or 50 stories high. If we could keep on steadily, without stopping to rest, it would take us nearly half an hour. The high-speed electric elevator can take us there in less than two minutes, and it is this that makes possible the tall hotels and office buildings of the 20th century.

The construction of these wonderful machines is not very complicated. Strong cables, with the car at one end and a counterweight at the other, pass over two pulleys or "sheaves" at the top of the shaft—first over the driving sheave, then over the second or "idler" sheave, and back over the first, making a complete loop. Wound like this, the cables cannot slip; for the greater the weight the tighter they pull. The counterweight of massive iron bars is made to weigh about as much as the car with an average load, so that the motor has only to lift the excess load. The weight of the steel cables—a considerable item—is balanced by a number of compensating cables attached to the bottom of car and counterweight, and passing under a sheave at the bottom of the shaft. The motor which turns the driving sheave in either direction is operated by a lever in the car. A brake, consisting of leather faced shoes acting on a brake pulley, holds the car at any point where it is stopped.

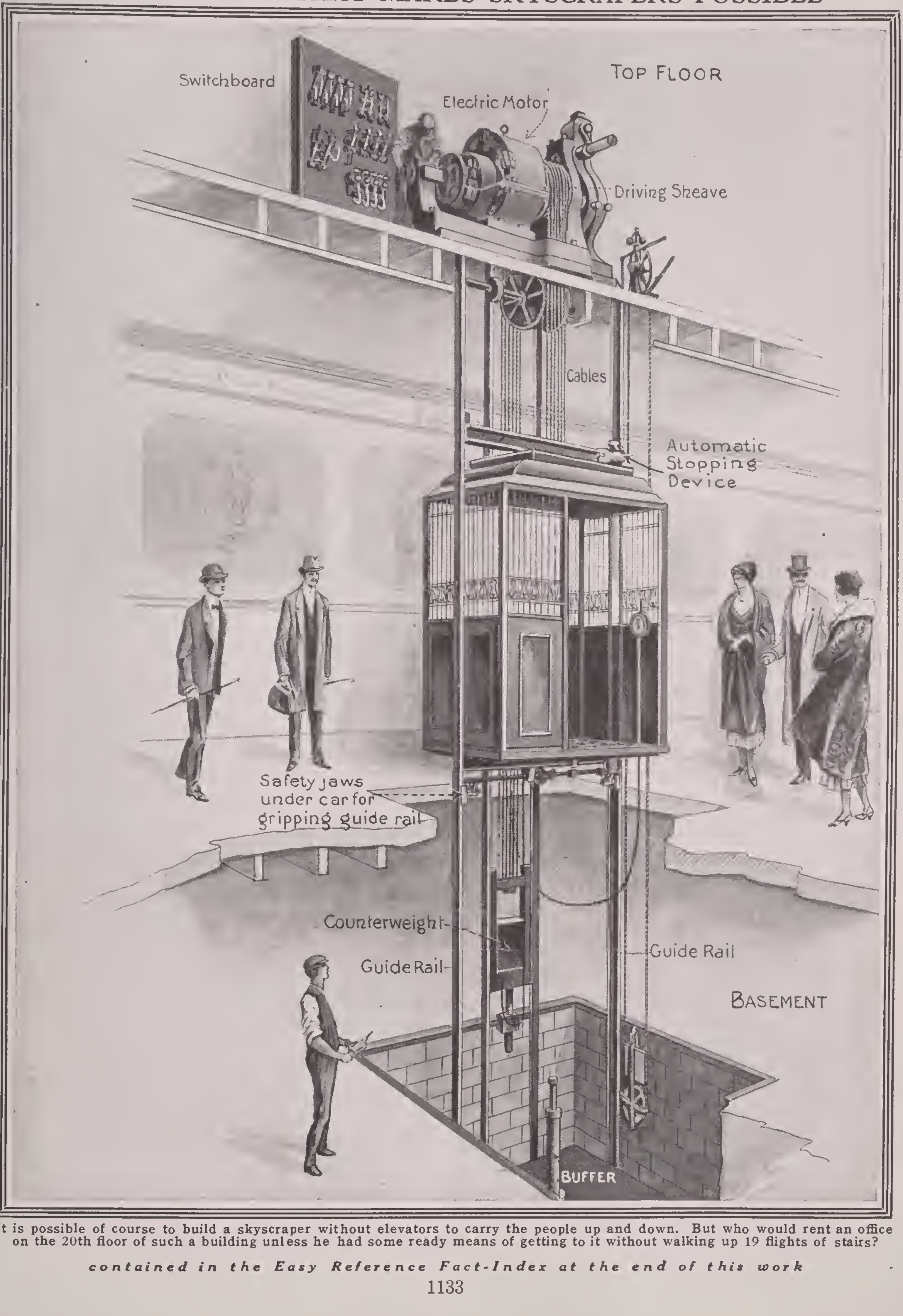
What would happen if the car should fall? It is not likely that it will, for six stout wire hoisting cables are generally used, each of them strong enough to hold up the weight of the car. But if they should all give way, there are powerful steel jaws on the bottom of each car, which reach out and grasp the rails on which the car rides, if the speed reaches a certain high rate. The brakes also set automatically when the power is shut off. In addition, cushion buffers are placed at the bottom of the elevator shaft to break the fall, should the other safety devices fail. These buffers consist of plungers fitted into tight cylinders filled with oil. When the car or the counterweight strikes the plungers, the oil is slowly driven from the cylinder into the outside casing, and thus the descent or ascent of the car is greatly checked. Another safety arrangement is the so-called "air cushion." In this type of installation, each car is enclosed in a separate "well," which is practically air tight at the bottom so long as the doors are closed. If a car should fall, it would compress the air in this shaft and thus create a "cushion" to check its drop.

Some small hotels and apartment houses have automatic elevators which can be operated by the passenger. Each landing has a push-button which brings the car to that floor unless it is already in use. In the car is a series of buttons, and by pressing the button corresponding to any given floor the car is dispatched to that floor. It is impossible to open the door unless the car has come to a full stop, and the car cannot be started while the door is open. Some "dumb waiters" —small elevators for sending dishes, etc., from one floor to another—are similarly operated.

The moving stairway or "escalator," is another form of elevator, used chiefly in elevated railway stations and department stores. It consists of an endless chain belt, set at about the same angle as a flight of stairs. Some are constructed with wooden slats as a footing, while treads and risers give others the appearance of an ordinary flight of stairs in motion. A hand rail moves along at the same rate of speed.

In the most familiar type of hydraulic elevator the car rests on a hollow pipe, which fits closely into a strong iron cylinder sunk into the ground as deep as the building is high. Two openings in the pipe let the water out and in. When water is forced into the cylinder by a powerful machine, the plunger, carrying

THE MACHINE THAT MAKES SKYSCRAPERS POSSIBLE



It is possible of course to build a skyscraper without elevators to carry the people up and down. But who would rent an office on the 20th floor of such a building unless he had some ready means of getting to it without walking up 19 flights of stairs?

contained in the Easy Reference Fact-Index at the end of this work

the car and the passengers, is forced upward. The water pressure is cut off when the car has gone as high as desired. When the operator wishes to descend, the outlet pipe is opened and the car sinks as the water escapes from the cylinder. A counterweight is used to reduce the amount of pressure needed. Elevators of this type cannot be used for very high buildings, more power is needed for operation, and their speed varies with the load. Another type of hydraulic elevator has a smaller cylinder, and the plunger, instead of being connected with the car itself, is connected with cables and pulleys, so geared that the car travels much faster than the plunger.

Elisha Graves Otis, in the early '50's of the last century, is credited with the invention which made the modern elevator possible—a device which prevents it from falling if the cable breaks. He also introduced a reversible steam engine directly connected to the hoisting machinery, which raised the car by winding a rope over a cylinder. In 1878 a hydraulic lift elevator was installed in the Boreel Building, New York City, and opened the era of modern elevators.

For many years the hydraulic type was supreme in the field, and even today finds considerable favor for handling heavy freight. For general use, however, the supremacy has passed to the electric elevator, the first of which was designed and built in 1884. The first important installation was in New York in 1889, and from that time on the use of such elevators spread rapidly. The development of the direct-traction elevator about 1904—the type in which an "endless" cable passes over a driving sheave, instead of a single cable being wound around a drum—completed the elevator as we know it today in our tallest buildings.

"ELIOT, GEORGE" (1819–1880). This is the masculine name under which Mary Ann (or Marian) Evans became famous as one of the world's greatest novelists. Born in Shakespeare's country, in Warwickshire, England, of an undistinguished family, she grew to womanhood on the beautiful old estate of Arbury Hall, of which her father, Robert Evans, was the manager. Thus she gained that intimate knowledge of English rural life which forms the charming background of several of her novels.

"GEORGE ELIOT"
England's Famous Woman Novelist

Called from a girls' Methodist school at Coventry by the death of her mother, Mary Ann Evans at the age of 17 became the sole companion and the housekeeper of a father of narrow mind and Puritanical strictness. In one way this was a fortunate circumstance, for, obliged to educate herself, she followed her own bent for the classical languages, German, Italian, music, philosophy, science, and ancient and modern literatures. Thorough in everything she did, she made herself a woman of wide and varied scholarship; but the years of loneliness left their mark.

She was not unknown when, at the age of 30, she went to London as assistant editor of the *Westminster Review*, for she had already contributed critical papers to that magazine and translated scholarly works from the German. So she was welcomed in the most distinguished literary circle. But in a group which numbered Spencer, Carlyle, and Mill, George Henry Lewes alone suspected that the genius of this intellectual but diffident country woman was preëminently creative, and urged her to write fiction. To Mr. Lewes as her friend and literary adviser the world owes a debt of gratitude. On the other hand, her connection with Lewes, which she regarded as a marriage without legal sanction—for Lewes' first wife was not divorced—shut her out from all society but his and that of a small group of faithful friends.

Mary Ann Evans herself had so little confidence in her powers and was so sensitive that she published her 'Scenes from Clerical Life' under the *nom de plume* of "George Eliot." The author was assumed to be a man; and she did not make herself known until two years later, when 'Adam Bede' won for her a unique and lasting fame.

George Eliot's instant popularity was extraordinary, coupled as it was with the recognition that no other thinker of her caliber, except Goethe, had used fiction as an instrument of thought. Her conceptions were of noble design, her style pure, and her stories significant. Her characters were analyzed with scientific accuracy, yet again and again she struck the unforgettable human note. She had deep feeling for her fictitious people and cared too much about them to be impersonal; nevertheless she is the least sentimental of women writers. Her novels are of such variety, interest, and individual distinction that there is no agreement as to which one out of three or four is her masterpiece. But it is agreed that all her stories owe their vitality to her marvelous delineation of character. Her poems are marked by scholarship and art, but lack the appeal of her prose.

To the end George Eliot's personal life was one of struggle and painful experiences. While she sustained with dignity and courage a difficult situation of her own conscientious making, she suffered from adverse criticism to a tragic degree, and was singularly dependent upon the watchful affection of those who loved her. She never recovered from the shock of Mr. Lewes' death, which occurred in 1878. Two years later she married John Walter Cross, but died in the same year and was buried in Highgate Cemetery, London.

George Eliot's principal works are: 'Scenes from Clerical Life' (1858); 'Adam Bede' (1859); 'The Mill on the Floss' (1860); 'Silas Marner' (1861); 'Romola' (1863); 'Felix Holt' (1866); 'The Spanish Gypsy' (a dramatic poem), 1868; 'Middlemarch' (1872); 'Daniel Deronda' (1876).

The STORY of SILAS MARNER

IN THE DAYS when cloth was woven on hand looms, the sociable hum of spinning wheels and the clatter of treadles came from many a cottage in many an old English village. As weaving was a simple trade that could be carried on anywhere, a workman now and then went off by himself. Thus it was that Silas Marner appeared in the rustic hamlet of Raveloe. A skilful weaver of fine linen, he soon had plenty of well-paid work to do, and should have won for himself a warm welcome. But he refused to give any account of himself, and made it plain that he wanted no neighbors. Setting up his loom in a hut on the moor, between the last hedgerows and an old stone-pit that was half-filled with foul water, he hid himself away from the world like a sparrow among the furze bushes.

There was much gossip about him, for such conduct was unnatural in a young man who was still under 25. His pallid face, too, had the look of one harassed by trouble or guilt, and with his prominent short-sighted brown eyes, which saw little beyond his own nose, he looked a staring, white-faced, furtive creature. So the stranger soon got an evil reputation that he did not deserve.

In truth Silas Marner had been a devout and respected member of a Methodist community of linen weavers. When church funds were stolen, suspicion was cast upon him by the real thief, who had been his nearest friend. Unable to prove his innocence he had fled from his home; and soured by treachery he distrusted and avoided all men. In his lonely cottage in Raveloe his life, no longer fed by human fellowship and faith in God, dwindled like a starved plant trying to grow in a cellar.

The Long Hours and the Hidden Gold

To forget his trouble he toiled long hours at his loom, and thus earned more than enough for his needs. Spending only the copper and silver, he put the gold away. And having no natural pleasures for the long lonely evenings, Silas Marner came to love his growing hoard of golden coins. After supper he locked his door and shutters, and lifted the leather bags of treasure from their hiding place under loosened bricks beneath his loom. The glitter of the coins as they trickled through his thin eager fingers, or stood in neatly counted piles, was sunshine to his warped and gloomy soul. In 15 years the heartsick young recluse was turned into a prematurely aging miser, who was known to the fearful children of Raveloe as "Old Master Marner."

One rainy evening, after his return from an errand in the village, he ate his supper, locked the door and shutters and, setting a candle on the floor, lifted the loose bricks. His gold was gone! Stark terror filled him, then wild despair. With a scream he rushed out into the rain.

"Robbed!" he gasped, "robbed!" as he burst into the Rainbow Inn that was full of gossiping idlers.

"He's off his head," said the landlord, for indeed the poor mud-stained and dripping weaver looked like a distracted ghost.

Officers of the law scoured the country, but neither the thief nor any trace of the gold was found. But Silas Marner's loss won for him the sympathy of his neighbors. He was stopped in the lanes by kindly inquiries, and Mrs. Dolly Winthrop, the wheelwright's wife, who was always first with help and comfort in a time of trouble, broke in upon his solitude. As an excuse for a friendly call she brought some sweet cakes.

"You doing all for yourself!" she said compassionately. "And men's stomachs are made that comical they want a change now and then—God help 'em."

"Thank you kindly, ma'am," said Silas with feeling, for there was no mistaking the simple neighborliness of this good woman. He had been living "in a withering desolation." Work filled his days, but for the lonely evenings there was no "phantasm of delight." The fires of life were burning low when Mrs. Dolly made his Christmas a little less cheerless with her friendly visit and gift. And all unknown to him a new life was coming with the new year.

The Storm and the Golden Haired Baby

Since there was nothing to be stolen he did not lock up his house when he went abroad. Coming home in a snow storm on New Year's Eve he found his door blown open by the wind. The fire had almost died, and when he stooped to mend it, suddenly to his short-sighted vision there appeared to be his gold heaped upon the hearth. But instead of hard coins his trembling fingers clutched the soft golden curls of a sleeping baby!

Long, long before, Silas Marner had had a little sister—just such another yellow-haired, pink and dimpled morsel of a girl as this. Tender memories stirred him, and when with a cry of "Mammy!" the child sat up, he lifted her to his knee. He fed her porridge with brown sugar, and took off her little soaked shoes. Breaking into happy chuckles, the baby played with her toes. When he found the mother—a wretched, wandering woman who was unknown in Raveloe—dead in the snow of a furze bush, he refused to part with the child.

"She came to me. I have a right to keep her. She's a lone thing and I'm a lone thing." He clung to her desperately.

"Well, I'm sure that's right," said Mrs Dolly Winthrop. "Besides she's a winsome little maid as it would break anyone's heart to see go on the parish." So Mrs. Dolly brought her own children's outgrown baby clothes, worn and patched, but as sweet and clean as spring blossoms, and showed the awkward but eager bachelor how to dress the rosy little waif. He wanted to do everything for her himself lest she grow fonder of someone else. Then he went to church to have his adopted child christened, naming her Hepzibah for his dead sister. But for that Biblical name, which overwhelmed Mrs. Dolly, he had a dear diminutive, "Eppie."

Eppie and Her Foster Father

Silas Marner had loved his gold in secret behind a locked door; but Eppie he loved in the sunshine before all the world, for the little girl was soon toddling out to the moor and along the English hedgerows. He could not leave her, but was obliged to take her with him on every errand. So when he bought supplies or delivered his webs of beautiful linen, he was met by friendly faces and inquiries. Everywhere he must sit awhile, and eat a bit, and talk about Eppie. An adorable little girl, Eppie was soon the pet of the countryside, and she linked her happy foster father again with the warm human world.

Very soon the active child was in every sort of mischief, so that when he worked at his loom, Silas had to tie her to the frame with a strong linen band. He never punished her but once. By Mrs. Dolly's advice he put her into the black coal hole, for running away to the dangerous stone-pit where she might have been drowned. Eppie, thinking this a new and delightful game, returned as soon as he had washed and dressed her. Peeping out with the blackened face of a laughing imp she cried:

"Eppie in a toal hole aden, Daddy. Opy door!"

The years went by—years of human cares and joys for Silas Marner. The hut grew to a neat stone cottage, and around it Eppie's blooming garden was fenced with furze bushes and stones from the moor. And Eppie herself grew to a winsome lassie of 17. Then in a season of drought the old stone-pit went dry, and Silas' gold was found at the bottom, with the bones of the thief who had stumbled to his death on that rainy night. And Eppie's father was discovered to be a gentleman, who had married her mother secretly and, finding her unworthy, deserted her. She could have become a lady and the heiress of an old manor farm, but she clasped her arms tight around the neck of the only father she had ever known.

But Eppie Clung to Silas

"Thank you, sir," she said. "Your offers are far above my wish. I should have no delight i' my life if I left my daddy and knew he was feeling lone. He took me in, a little child, when you deserted and denied me, and I can't feel as I've any father but him. And here he'll sit, when he is old, with me to fend for him." She ended with a gush of warm tears. "I'm promised to marry Aaron Winthrop, as'll live along o' father and help me care for him."

So when the lilacs and laburnums bloomed above the lichened walls, the bell pealed from the ivied tower of the village church, inviting everyone to a wedding. After a feast in the Rainbow Inn, three happy people went home to the cottage on the moor.

The GLORIOUS REIGN *of* GOOD QUEEN BESS

ELIZABETH, Queen of England (1533–1603). The long reign (1558 to 1603) of the "Virgin Queen" proved to be one of the most important in the annals of English history. Elizabeth established England as a Protestant kingdom, she saw the country well on the way to become mistress of the seas, and in that period occurred the greatest burst of literary activity the world has seen since the days of ancient Greece.

Elizabeth, the daughter of Henry VIII and Anne Boleyn, was born in 1533. Brought up under the cloud of her mother's execution and her father's dislike, she was finally recognized in his will as heir to the throne after her half-brother Edward and her half-sister Mary. During the Catholic reaction under the latter, Elizabeth's known friendship for Protestants caused her to be thrown into the Tower and she was charged with a plot against the unpopular Mary. She survived this danger, however, and at the age of 25, on the death of Mary, was summoned to the throne amidst the rejoicings of the Protestants and of many moderate Catholics.

Remarkable Personality of Elizabeth

Elizabeth possessed rare natural qualities which had been sharpened by hard schooling in the world of men and books. In her puzzling and contradictory character may be seen her mother's vanity and uncertainties of temper, the caution and prudence of her grandfather, Henry VII, the imperiousness and charm of manner that early made Henry VIII irresistible, and the unscrupulousness of the whole line of Tudors. In her youth Elizabeth was striking and attractive. Her figure was tall and well proportioned, she had a broad commanding brow, a fine olive-tinted complexion, hazel eyes, and a profusion of auburn hair. Endowed with remarkable physical vigor, she could hunt all day, dance or watch masques and pageants all night, and when necessary apply herself unremittingly to official duties. She was masculine in her coarseness of word and action, and her stinginess was notorious. Carefully trained under the best teachers of the day, she spoke French and Italian with ease. She knew some Greek, and could speak with an ambassador in Latin if necessary. She was proficient in music, though she cared little for poetic and dramatic literature.

Elizabeth's first step as queen was to restore the reformed church practically as it had been under Henry VIII and Edward VI. For the next 30 years, aided by well-chosen counselors, she struggled to maintain England's independence from foreign control, and a compromise religious settlement. While everybody was compelled to attend the services of her "Established Church" or pay a fine, Elizabeth made it as easy as possible for both moderate Catholics and Protestants to attend her church without offending their consciences. She thus succeeded in winning the support of the majority of her subjects.

Yet a large Catholic party in England was plotting to put Mary Queen of Scots, whom they regarded as the rightful queen, on the throne in place of Elizabeth. They sought for their plots the aid of the pope, of the new and vigorous religious order of the Jesuits, and of the Catholic countries France and Spain. Elizabeth strove to hinder these plans by elaborately pretending that she was going to marry either the king of Spain or some French prince. To make trouble for her enemies, she aided the Protestant Netherlands when they revolted from Spain, and also helped the Scots when they went over to the Protestant cause.

WHEN SIR WALTER SPREAD HIS COAT

Who has not heard the story of Raleigh's gallantry? He had a fine cloak and he was proud of it; yet when he saw Queen Elizabeth coming to a muddy spot in the road, he laid it over the mud to make a dry path for her. His courteous action greatly impressed the Queen, and he rose high in her favor.

As a result of this change in Scotland, Mary Queen of Scots was compelled to flee across the English border where she fell into the hands of Elizabeth's officials (1568). Elizabeth's advisers urged her to have her rival executed as the indispensable means to her own safety. Not until 20 years had passed, and the King of Spain was gathering a great fleet to invade England, did Elizabeth yield to this advice and sign the death warrant of the Scottish queen on the ground of a plot against Elizabeth's life.

Now took place the most glorious event in Elizabeth's reign, the defeat of the Spanish Armada (1588). All England gathered itself to meet the foe. Elizabeth showed the courage of her race, when, clad in armor, she made a ringing and patriotic speech to her troops. Yet the credit for saving England belongs largely to others. She was the last to believe that the Armada was coming, and was so penurious in fitting out and provisioning the English navy as to risk defeat and prevent the victory from being as complete as it might have been. The real credit for the Armada's defeat is due to the skill and courage of the great English captains of the time and the generous gifts of English merchants. (*See* Armada, Spanish.)

But by this glorious victory England freed herself from the fear of a Catholic reaction and entered upon her great career of sea power and colonization. The Englishmen of that day felt a glorious new sense of power which found expression in the writings of a group of brilliant men whose works have shed undying glory on the reign of Elizabeth. Supreme among these shone the immortal Shakespeare. It is in his verses that the new pride and love for England is most beautifully expressed—

> This royal throne of kings, this sceptered isle,
> This earth of majesty, this seat of Mars,
> This other Eden, demi-paradise,
> This fortress built by Nature for herself
> Against infection and the hand of war,
> This happy breed of men, this little world,
> This precious stone set in the silver sea, . . .
> This blessed plot, this earth, this realm, this England.

Elizabeth's Affairs of the Heart

Though Elizabeth never married, her suitors were numerous and she kept them dancing attendance until she was an old woman. Perhaps her heart was most deeply touched by Robert Dudley, Earl of Leicester, master of the horse, handsome and clever, husband of the ill-fated Amy Robsart. Her next favorite was the equally ill-fated Earl of Essex, whom Elizabeth alternately loved and scolded, seeming to care for him much as a mother cares for a spoiled child. Yet when he was condemned for armed rebellion Elizabeth forced herself to sign his death warrant. Motives of state policy, the dislike of her imperious nature to give herself a master, and perhaps a certain coldness of temperament account for her refusal to heed the wishes of her people to take a husband. It is to be noted to her credit that she did not permit her personal favorites to influence her action in matters of state, but consistently followed the advice of chosen and sagacious ministers.

The religious question, the defeat of the Armada, and the flourishing of literature are the things we think of chiefly as marking the reign of the great Elizabeth. Not less memorable, however, are the hundreds of important laws—on shipping and commerce, roads and industry, poor relief and agriculture —which shaped the policy of England for more than two centuries after she and her statesmen advisers were in their graves. In fact, the reign of Elizabeth marked the passing of the main features of the Middle Ages, and the birth of modern England.

Elizabeth's vanity, her fondness for dress, her love of flattery and attention often made her appear ridiculous in her old age, yet she was ruler of England to the last. Not the least of her achievements was the fact that at her death in 1603 she aided the peaceful accession of her relative, the Scottish king, the Protestant son of Mary Queen of Scots, who became James I of England, and so brought about the permanent union of England with Scotland.

ELK. The largest existing representative of the deer family; in America the true elk is called the moose. The name "elk" is erroneously given in the United States to the "wapiti," a member of the red deer group which once numbered milllions but has been reduced to about 40,000, found chiefly in the Yellowstone National Park region. (*See* Moose; Wapiti.)

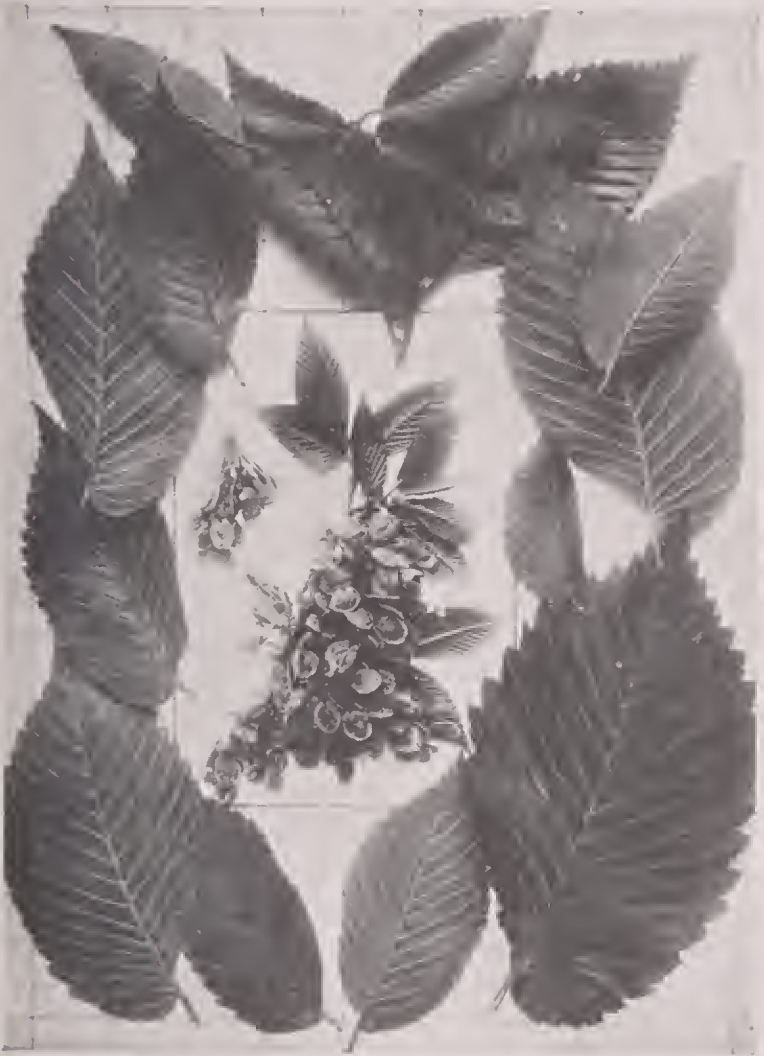
ELM. The American or white elm is a tree dear to all familiar with New England, and is famous in American history. Every schoolboy has read of the "Washington elm" at Cambridge, under which Washington stood when he took command of the American army, and of the elm under which William Penn made treaty with the Indians. The American elm is a magnificent tree, sometimes towering to 125 feet, its height and its great arching limbs presenting a most stately and graceful appearance. In many New England towns the long arms reach quite across the wide roadways. Such elms are veritably of a race of giants, many specimens being known with trunks exceeding six feet in diameter. The range of the species is from Newfoundland to Florida and westward to the Rocky Mountains. In recent years caterpillars of the gipsy and brown-tail moths, and certain tree diseases have done irreparable damage in spite of millions of dollars spent by the state and national governments in combatting them, and some of the finest of these once glorious trees have been destroyed.

THE "WASHINGTON ELM"

It was under this interesting specimen of its family that George Washington is said to have assumed command of the new Continental Army on July 3, 1775, while the colonists were besieging Boston after the battle of Bunker Hill. The tablet sets forth the historic importance of the tree.

The slippery elm, also called the moose or red elm, is another American species. Its inner bark has a pleasant taste, becoming slippery or slimy when chewed, and was once supposed to have medicinal qualities. The tree grows to 60 or 70 feet in height and has a broad flat crown and spreading branches.

FLOWERS AND LEAVES OF THE ELM



The elm leaf is of the "serrated" or saw-tooth type, and its beauty in masses helps greatly to make the elm a favorite as a shade tree. The elm is noted for its graceful lines, with a trunk rising straight up to a noble height and branching out regularly to support a solid, smoothly outlined mass of foliage. The flowers are small and inconspicuous.

The English elm (*Ulmus campestris*) is a worthy rival to its American brother, growing in moist situations to a height of 130 to 150 feet. Its branches also are numerous and spreading, and its bark rugged. Besides the British Isles, it is a native also of the European continent, North Africa, and certain parts of temperate Asia. It has been widely planted as an ornamental or shade tree in the United States. The cork-barked elm is a variety of English elm, so named from its deep-fissured corklike bark.

The wood of the elm is close-grained, hard, and tough, but will not take a polish. It is remarkably durable under water but decays rapidly when exposed to the weather. One of the uses to which it has often been put is the making of coffins.

Scientific name of American elm, *Ulmus americana*. Bark ashy gray, rough. Leaves simple, alternate, oval with taper-pointed apex, unequal sides, from 2 to 6 inches long. Flowers inconspicuous, greenish-red, growing in close drooping clusters, appearing before the leaves. Fruit small winged green seeds.

EL PA'SO, TEX. As the only large city along the Mexican border, El Paso is the main gateway from the United States to Mexico. It is the trade and distributing point for a large part of the southwestern United States, having no rival in size or commercial importance for 600 miles in any direction. Several railroads converge here, and across the Rio Grande is the Mexican city of Juarez, the terminus of the Mexican Central Railway. The city gets its name from the fact that it lies near the lowest pass across the Rocky Mountains, about 3,800 feet above sea-level. The completion of the great Elephant Butte Dam, the third largest dam in the world, impounding the largest artificial lake in the world, 120 miles up the Rio Grande valley, has made El Paso the center of a rich fruit and vegetable district.

Nearby supplies of coal and coke in New Mexico furnish cheap fuel for the leading industry—smelting the ores from the great tributary mining region—and for foundries, machine shops, railroad shops, flour mills, and other establishments. Enormous pine forests in Arizona, New Mexico, and Mexico supply the lumber for what is said to be the largest wood-finishing mill in the world. The live stock industry is also becoming important.

Since the first railroad reached it in 1881, El Paso has enjoyed an amazing growth, and it doubled its population between 1910 and 1920. Although the site was early visited by Spanish explorers, the first settlement dates only from 1827. The city was incorporated in 1873 and adopted the commission form of government in 1907. Six miles northeast is the important military post of Fort Bliss. Population, about 80,000.

EMANCIPATION PROCLAMATION. The most important proclamation ever issued in the United States was that issued by President Lincoln on Sept. 22, 1862, announcing to 3,000,000 slaves that, if their masters were still in rebellion on the coming New Year's Day, they should be free from that date on. The abolitionists had long been urging Lincoln to take this step and had severely criticized him for refusing to do so; but Lincoln had replied, "My paramount object is to save the Union, and not either to save or destroy slavery." If he had decreed emancipation at the beginning of the war, Missouri and Kentucky, and probably Maryland, would have joined the South. After the war had been in progress for over a year there was no danger of this. On the other hand, if the slaves continued to produce food for the Southern armies, there was danger of the North being defeated. Lincoln had accordingly drawn up an emancipation proclamation in July 1862, and laid it before his cabinet. All but one of the members agreed with his policy. Seward approved, but urged that the proclamation should not be issued at that time, for the Northern armies were being defeated and it would seem that the North was appealing to the slaves for aid instead of aiding them. Lincoln agreed to the postponement, but vowed that as soon as the Confederate troops were driven out of Maryland he would issue the proclamation. The occasion came with the victory of Antietam, on September 17, and a preliminary proclamation was issued on September 22. The slaveholders paid no attention to its warning, and so on Jan. 1, 1863, Lincoln issued the final proclamation.

> And from that rich and sunny land
> The song of grateful millions rise,
> Like that of Israel's ransomed band
> Beneath Arabia's skies.—*Whittier.*

The final proclamation did not apply to the border states which were not in rebellion, and it could not be enforced in the regions held by the Confederate troops. But as soon as the Northern armies captured a region, the slaves there were given their freedom. The remaining slaves in the United States were freed by the 13th amendment to the Constitution (ratified Dec. 18, 1865), which decreed that "neither slavery nor involuntary servitude, except as a punishment for crime whereof the party shall have been duly convicted, shall exist within the United States, or any place subject to their jurisdiction."

EMBARGO ACTS. Over a hundred years ago England and France were engaged in a long continued and desperate war, growing out of the French Revolution and the usurpations of Napoleon Bonaparte. England interfered with neutral vessels going to lands ruled by the French, and Napoleon declared that vessels which obeyed the English orders should be seized. American commerce suffered severely. President Jefferson thought to end these oppressive acts, without going to war with either country, by laying an "embargo" on American commerce—that is, by forbidding American vessels for a limited period from putting to sea. He thought by shutting off supplies from both countries he could bring one or the other of them to reason. The embargo lasted from December 1807 to March 1808. It made little impression on England and France, but almost ruined American commerce. Grass grew in the streets of the towns engaged in foreign trade and New England talked of seceding from the Union. Although the embargo was repealed, its ill effects were long in disappearing. It did not even save the United States from the necessity of protecting its rights by force of arms, in the War of 1812 (*see* War of 1812).

At times the word "embargo" means a prohibition by law against the unauthorized export of some particular goods. Thus, during the World War which began in 1914, Great Britain placed an embargo on wool, because of the great need of it for soldiers' uniforms and blankets. The United States adopted similar measures, after it entered the war. The measures which Great Britain adopted to shut off the trade of neutrals with Germany and her allies were sometimes referred to as an embargo, although "blockade" is a better term to describe them. At times the term embargo is also used in a more general sense, such as an "embargo" against railroad shipments, for a limited period, to points where freight is greatly congested.

EMBROIDERY. Men have said that women have created no art. One among the many things they overlooked was embroidery. The commonest form of decorative needlework, it is found in every home, giving its attractive touch to household linens, children's and women's garments, etc.

Most ancient nations apparently knew how to embroider. The sandy soil and the dry climate of Egypt have preserved examples of embroidered stuff which were made more than 3,500 years ago, and among the primitive tribes of Central America, where the art of weaving is hardly known, the girls embroider skins very elaborately, using bright shells and feathers. All materials—silk, velvet, wool and cotton—have been used as the ground for "needle-painting," as embroidering was termed in the Middle Ages, when it ranked in dignity with painting and sculpture and was practiced by men as well as women. Many beautiful pieces of medieval embroidery still survive to tell us of the art and picture the life of those far-off times. One of the most famous is the Bayeux Tapestry, which contains 72 scenes embroidered in colored wools telling the story of the Norman conquest of England.

The people of the Orient excel in the art today as they did in ancient times. The woolen shawls of Cashmere are still famous, and the Chinese embroidery, exquisite in design and workmanship, has been unchanged for ages.

There are many different kinds of embroidery stitches, most of them very ancient. "Couching" is the method by which thread is sewn down by another thread on the material. Cord and gold braid are generally couched. Complicated machinery has been devised which duplicates many embroidery stitches, at much less cost than that of handwork. Hundreds of tiny needles move up and down as in a sewing machine, and the same number of shuttles underneath the fabric pass through the loops of thread to form the stitches. An ingenious and complicated attachment, like that used in the Jacquard loom, governs the making of the design (*see* Spinning and Weaving).

EMBRYOLOGY. The building of an animal's body is the most wonderful thing in all nature. An insect, a fish, or a bird begins its development as an egg, and, as the construction of the body goes on, each tissue and each organ are formed anew out of the materials contained within the egg.

After three weeks' incubation of the hen's egg, for example, the young chick steps into the world with heart, brain, eyes, and other organs all formed—a remarkable transformation. Frogs' eggs, laid in the water, undergo similar changes without any care from the parent; tadpoles hatch from them, and in due course of time these tadpoles grow into frogs, with a different kind of body.

The hen's egg is large, because there is a large quantity of food-yolk stored up for the use of the growing chick; the frog's egg is smaller, because it contains less yolk; and some eggs—for example, those of starfishes—are smaller than pin-heads.

The true starting point of the chick is a tiny cell within the egg—so small it can be seen only under a microscope; and when we look to other animals we find that all of them, no matter how complex, start from a similar tiny cell. Between that simple state and the fully formed animal there are many steps. Therefore the adult stage of any animal represents the last step in a long series of changes.

If we could only follow these, step by step, we should understand all about the construction of animals and their past history. Tracing the stages by which cells emerge into tissues, tissues into organs, and how the organs by combination build the body is called embryology.

It is an important fact to keep before us that the rudiment of all life is a cell (*see* Cell). If we look upon cells as the bricks of organic architecture, the starting point of a many-celled animal is a single brick; but, inasmuch as each egg needs to be fertilized before developing—just as a plant-ovule must be fertilized by pollen before it becomes a seed—the single brick is a compound one, made of material derived from each parent.

The development of all animals is remarkably alike. From the single cell there come, by division, many cells; these continue to feed on the yolk, to grow and divide; and thereby a large number of cells arises. These cells arrange themselves into definite layers, and it is from these layers that all parts of the body are formed.

It took over a half-century after Harvey and Wolff in the first half of the 18th century for this view of cell development to replace the earlier view that the animal existed already formed within the egg, but was exceedingly minute, and that development consisted in the expansion or growth of this animal in miniature. Then K.E. von Baer (1792–1876), the father of modern embryology, showed that all the tissues and organs come from cell-layers or germ-layers. One layer gives rise to nerves, another to skin or feathers or fur, and a third splits and from it come the internal organs, bones, etc. This is the germ-layer theory.

Other scientists broke down the rigid line that was supposed to separate vertebrated and invertebrated animals (those with backbones and those without), and indicated how higher types had been developed from simpler ones. The chick, and for that matter man himself, in the embryo has gill clefts like a fish. These disappear but they give clues leading to the time when all were water-breathers and had use for gills. Thus embryology retraces life's history, contributing important evidence in support of the belief that the higher animals have been evolved gradually from the simpler ones. (*See* Evolution.)

The SAGE *of* CONCORD *and His* TEACHING

EMERSON, RALPH WALDO (1803–1882). No American writer had a more powerful influence on his generation than did Emerson, and none has better stood the test of time. His appeal is universal. Young and old, wise and simple, learned and untaught, turn to him again and again for refreshment. Some of the keenest and best minds in both the Old World and the New have accounted his message of resolute self-reliance as one of the cardinal factors that shaped their lives and thinking.

Emerson's ancestors were Puritans who came to New England in 1635. He sprang from eight generations of ministers. Emerson's father died when the boy was eight years of age, leaving the family poor. He went to Harvard in 1817 and, although elected class poet on graduation, he received no honors for scholarship. Even in those early days he preferred to seek his own mental food rather than to follow meekly the paths laid down by his teachers.

On leaving college, Emerson taught in his brother's school for awhile and then studied for the ministry. His preaching, however, was interfered with by poor health and he was forced to go South. On his return he accepted a Unitarian pastorate in Boston and was married to Miss Ellen Louisa Tucker.

RALPH WALDO EMERSON
The Teacher of "Self-Reliance"

Through all his early years Emerson had been a quiet unobtrusive self-contained person. He thought much, wrote a little, and said less. He was genial and kind in his attitude toward people around him, but he was always most difficult to know intimately. His early married life was happy; and for the first 30 years of his life he seemed destined to follow peacefully in the footsteps of his ministerial ancestry. But underneath the quiet exterior was a steadily growing resolve which was to separate him from the church. Emerson found that even in the simple ritual of the Unitarian service there was much to which he could not agree. He resigned his position as minister, greatly to his relief.

For a time he did not find himself. His young wife died in 1831 and Emerson's own health broke down again. He went to Europe, saw the wonders of the Mediterranean countries, and visited England. There he met most of the great men of letters of the day: Landor, Coleridge, John Stuart Mill, and above all, Carlyle, whom he admired more than any. But it is curious to see that travel and great men meant but little to Emerson. He said in his essay on 'Nature', published some years later: "The difference between landscape and landscape is small, but there is a great difference in the beholder." As for the men, they seemed to him inferior in intellect, except Carlyle, with whom he corresponded for many years.

On Sept. 14, 1835, he married Miss Lydia Jackson. Prior to this time he purchased a house with a pretty garden attached, in Concord; and there, surrounded by his family, he passed the remainder of his life, save for the breaks occasioned by lecture engagements and two journeys to Europe. When his house was burned, in 1872, a nation-wide popular subscription was taken and the funds used to rebuild it. He died after a short illness on April 27, 1882, and was buried in Sleepy Hollow cemetery on the outskirts of Concord.

To understand Emerson's aloofness from men and events one must grasp his way of thinking. He believed that great truths come to us by intuition—that is, that they come to us unbidden. Furious striving avails us nothing; truth comes gently and unawares. Most modern philosophers do not agree with Emerson; they think that truth may be reasoned out. Besides, they are interested in the working out of truth in relation to human life, while Emerson was always on the alert for the first dawning. He never finishes but is always beginning, and his beginnings have been inspirations to the people of two continents.

EMERSON'S TRIBUTE TO BEAUTY

> *"Wherever snow falls, or water flows, or birds fly, wherever day and night meet in twilight, wherever the blue heaven is hung by clouds, or sown with stars, wherever are forms with transparent boundaries, wherever are outlets into celestial space, wherever is danger, and awe, and love, there is Beauty, plenteous as rain, shed for thee, and though thou shouldst walk the world over, thou shalt not be able to find a condition inopportune or ignoble."*

How are men to arrive at truth? Emerson gives his answer in 'Self Reliance'. "To believe your own thought, to believe that what is true for you in your private heart is true for all men—that is genius. Speak your latent conviction and it shall be the universal sense; for always the inmost becomes the outmost—and our first thought is rendered back to us by the trumpets of the last judgment." "God is in every man." The last phrase is the keynote of what is called the "transcendental movement," or that faith in the "inner light" of which Emerson was the chief exponent.

When Emerson returned to America he had begun to lecture and to write freely. He edited *The Dial*, a paper which spoke truth fearlessly, for a few years. Harvard asked him to give several addresses, one of which, 'The American Scholar', was called by Oliver Wendell Holmes "our intellectual Declaration of Independence." His lecture tours carried him all over the country. In those days, one must remember, travel was a series of hardships and inconveniences. Emerson reached a large number of people, most of whom did not understand him at all.

There was something more than truth that drew the crowds. It holds us now when we read the essays in a quiet room; it holds the thoughtful young soldier on a crowded troopship. But in the early days people often came to scoff and remained to listen, much impressed. Emerson the man held them. He was a man of charm and vigor; he had a style which is almost unequaled. Oliver Wendell Holmes said: "No one who ever heard him speak will forget the play of his features, the lighting up of his eyes with a rapt inner illumination, the emphatic stamp of his foot when some weighty thought required enforcement." In the matter of style he stands supreme for his power of saying much in little, of so phrasing his thoughts that they sparkle and glow. Every sentence seems as good as the one it follows. This is true of his poetry as well as his prose—that is, the power of stating truth in sharp relief. His poems are among the greatest ever written in America.

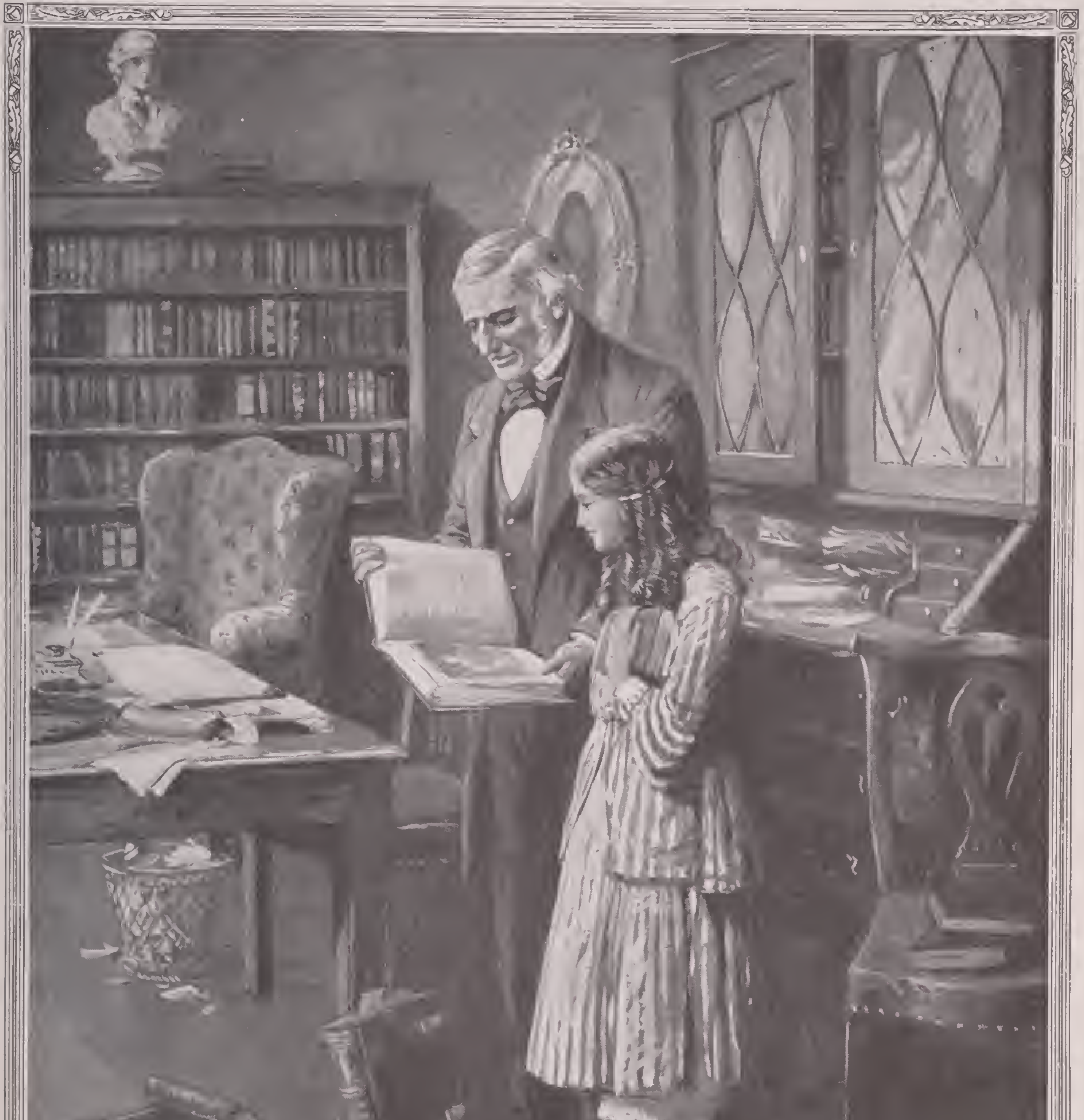
Emerson has been criticized for the lack of organization or plan in his essays. But we must remember that he never tried to put plan there. One might say that he was too honest. He said what he had to say, as it came to him, and considered himself as the mouthpiece. Emerson is still read—he is read more and more as the years go on, while many of his critics are forgotten.

Emerson's principal works are: 'Essays, First Series' (1841); 'Essays, Second Series' (1844); 'Poems' (1847, 1865); 'Representative Men' (1850); 'English Traits' (1856); 'The Conduct of Life' (1860); 'Society and Solitude' (1870).

EMERY. In outward appearance emery has nothing in common with the sapphire and other precious stones to which it is related. It is a dense, opaque, dull substance, like a fine-grained iron-ore, ranging in color from reddish-brown and gray to blue-black. It is found in large bowlder-like masses in Asia Minor and on Naxos and some of the other islands of the Grecian archipelago. Small amounts are found in the United States. The rock is made ready for use by breaking it into lumps and crushing these to powder in stamping-mills. It is then sifted to various degrees of fineness. As emery-powder is next in hardness to diamond-dust and crystalline corundum, it is used for cutting and polishing many kinds of stone. Glass stoppers are ground into their fittings with it. Plate-glass is ground flat by its means. When used for polishing metals, it is spread on some kind of surface to form emery-paper, emery-cloth, or emery-sticks. Emery-wheels, used for grinding, are a mixture of emery-powder and some cementing substance.

Emery is an impure variety of the mineral *corundum*, which is chemically an oxide of aluminum. The beautifully colored crystalline varieties of corundum are known as sapphire, oriental ruby, oriental topaz, etc. Corundum in less beautifully colored forms is used like emery for grinding and polishing. Ontario is the chief source of supply.

THE PHILOSOPHER AND THE LITTLE GIRL AMONG THE BOOKS



Of course you know this is Ralph Waldo Emerson, and you can see that he is talking books with the young girl; but who do you suppose that girl is? She is Louisa May Alcott, author of "Little Women"! When she was a little girl, living there in Concord, she used to be a regular visitor at the home of the Emersons, and she spent many happy hours with the great man, who used to go about with her among the books and help her pick out the ones he thought she would like best and that it would do her the most good to read. The scene is typical of the many happy gatherings in Emerson's home, for it was a favorite meeting place for writers, philosophers, and other notable figures from all parts of the country.

LITTLE TALKS ON GREAT THINGS

by Arthur Mee

EMOTIONS

IT IS one of the great dangers of the world that emotion easily overwhelms our reason, and we should guard with all our might against this temptation. Nothing could be more fatal then to let emotion seize the reins and lead us blindly on in spite of reason itself. It is easy to see how harmful this is, if we only think for a minute; but the pity is that emotion can drown the power of thought and reason, so that even gentle natures become hard when they are greatly moved. We have all heard the saying that we must often be cruel to be kind, and we can only follow that wise advice if we have full control of our feelings at all times.

It is not easy to restrain the natural feelings of pity that come to us when we see or hear sad things, and it will be a sad day for the world when sorrow and pain cease to stir our feelings. But it would be worse for us all if, in our pity, we shut our eyes and hearts and minds to other considerations. We must be strong enough to bear the sight of pain for healing's sake, or where would doctors and nurses come from? We must be stern enough to punish wrong-doing, or what would become of peaceful people? It is right that we should regret the need of causing pain, but it is wrong that we should shun the painful duties that we owe to ourselves and to others. We must learn to look wisely on all sides of life, and not give way to the feelings that belong to only one side of things.

In a well-balanced life our reason must have full control of our emotions. We must think long thoughts, not only for the moment and the hour. We must not let momentary feelings, lightly roused, govern our vital acts. We must not let one emotion seize and control us and dominate our lives. We must not let our love of dogs, for example, blind us to the fact that sometimes, at the cost of a little pain to one of these brave animals, doctors may save the lives of children. We must not let any emotion so utterly possess us that we are carried away by it, like the woman who, not long ago, declared that she "would as soon lose her child as her dog." That is a pitiful example of the way in which emotion, allowed to run wild, disturbs the even and reasonable balance of the mind.

Without this balance, this careful adjustment of the scales of reason and emotion, our lives must lose much of their happiness for ourselves and much of their usefulness to others. The life that is governed by emotions lightly roused finds its way into narrow grooves, and too often stays there. Let us lose all things before we lose our pity, but let us control our pity wisely, tempering mercy with judgment. A wise man once said that to the envious man the world is like a cracked bell, from which only discord and no music comes; and even good people, by narrowing down their lives in little grooves, may get one-sided views of everything, and be a hindrance rather than a help in the world.

All through our lives we shall be forming our opinions, fixing our attitude to this or that great movement, resolving which side we will take on a hundred questions. From all sides the appeal to our sympathy will come, and in the stress of life, in the midst of all its clashing interests, it will not be easy to decide. Often it will seem that two ways are right when only one can be taken, and often the way that seems right will mean pain to those we love, or suffering to ourselves that we could avoid by pursuing another way. And sometimes it will seem as if to find truth is quite impossible.

When these times come we shall do what seems to us right; we shall listen to the still small voice within us which never yet has led any one of us astray. We shall remember not merely the things that crowd upon our minds at the moment, but the way in which the acts of our lives are wrought into a chain that never ends, but links the human race from age to age. In all things we must keep in mind the ultimate purpose of Life.

So our minds will widen and deepen and strengthen as we grow up, and will winnow the wheat from the chaff. So we shall blend the dictates of our minds with the feelings of our hearts. We shall not split up our lives in little compartments, caring only for a few things; we shall remember Rowland Hill's old saying, that "I do not think much of a man's religion unless his dog and cat are the better for it"; and we shall let the stream of our life flow wide and free. We shall touch our emotion with reason and our reason will be touched with emotion.

EMPLOYERS' LIABILITY. According to the "common law" in England and America, a workman when taking employment agrees to assume all the ordinary "risks of industry," including not only those resulting from his own negligence but those due to the carelessness of his fellow workers. With the increasing use of machinery and steam power, accidents in industry became very common, and in the large establishments vast numbers of men were considered "fellow servants" in the eyes of the law, making the recovery of damages impossible in the great majority of cases. An Employers' Liability Act was therefore passed by the British Parliament, in 1880, which defined and enlarged the employer's liability and gave compensation, whether or not the accident was due to the negligence of fellow workers. Similar acts were later passed in most of the states of the United States.

Such laws, however, still made it necessary in most cases for the injured workman to go to law to recover compensation, which is often expensive. They have therefore been largely replaced by workmen's compensation acts, which provide definite compensation for accidents. Most of the states now have either employers' liability or workmen's compensation acts, and a federal statute applies to public employees and to persons engaged in interstate commerce.

The extension of employers' liability has resulted in the growth of "employers' liability insurance," by companies which undertake, in return for a premium paid by the employer, to pay any damages to workmen for which the employer may become liable. Recent laws in some states make such insurance compulsory. The result of these laws is to force employers to use safer machinery and better working conditions, and otherwise remove many just grievances of employees.

EMU (ē′mū). Closely related to the cassowary, this running bird of Australia lives on the plains, as the cassowary does in the forest and dense scrub. The emus, however, have no cap or helmet such as the cassowaries wear. Also the head and neck are not bare as in the cassowaries, but are provided with feathers. The plumage is heavy and dull brown in color; it has no ornamental value. The wing-rudiments are very small. The bird stands about five feet high, ranking next to the ostrich in size. Its food is exclusively vegetable, consisting of fruits, roots, and herbage. It may be tamed, and breeds easily in captivity. It lays six or seven dark green eggs, nearly as large as ostrich eggs, in a cavity scooped in the earth, usually in sandy soil. The male and female both assist in hatching them. Scientific name, *Dromaeus novaehollandiae*.

HATCHING THE EGGS IN BATCHES

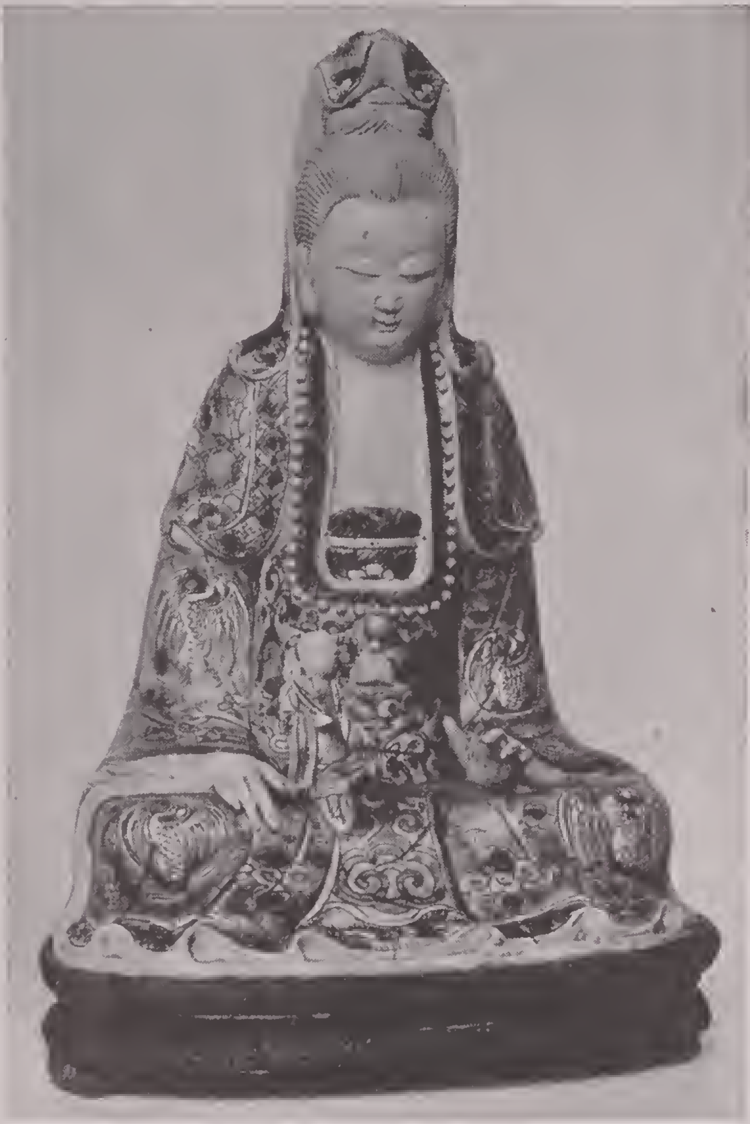
The bird in the foreground is Mrs. Emu. After she laid the first batch of eggs, Mr. Emu sat on them and, you see, has begun to hatch them out, while Mrs. Emu has gone on laying another batch of eggs on which she will sit while Papa Emu looks after the firstborn of the family.

ENAMELING. The marvelously delicate pieces of "cloisonné" ware in the jeweler's window, the exquisite glazed decoration of cups, plates, and vases carefully preserved in museums, much of the dazzling white equipment of our bathrooms, graniteware, and the shining blue and white kitchenware which never rusts, and the dials of our watches, are all examples of enameling. Enameling means coating a base of metal, pottery, or other mineral substance with finely powdered glass and then heating it until the particles melt together and form a glaze.

Enameling as an art has a long history. The ancient Egyptians and Assyrians used enameled bricks of wonderful luster in the walls of their palaces. They also used enamel in the decoration of jewelry. The Greeks and Romans were masters of the art, employing it both in jewelry and as an accessory of sculpture. In Ireland and England numerous ancient enamel ornaments have been dug up, including jewels, pins, harness plates, etc., of many different colors. Ancient shields and helmets were studded with enamel colored to resemble coral and precious stones. Many old crowns have enamel ornamentations. Evidences are many that the art early existed also in Persia, Asia Minor, southern Russia, China, Japan, and India. Today the Japanese are especially famous for enamel work.

One of the most beautiful of enamel wares is the cloisonné ware, mentioned above. Thin metal strips are soldered to a basis (usually of the same metal) to form a design. The little cells thus outlined are then filled with enamel pastes of various colors—bright hues for flowers, green for leaves and branches, black for shadows. The piece is then baked or "fired" several times until the enamel has been built up to a sufficient height. When the last firing is safely over, there follow weeks of polishing with pumice stone under running water. During this process the rough surfaces become smooth and shining, until the finished work appears a thing of marvelous beauty in color and design.

A SPLENDID EXAMPLE OF CHINESE ENAMEL



This figure of Kwan-Yin, which now belongs to the Victoria and Albert Museum in London, shows the mastery possessed by the Chinese artists of enameling over porcelain. The perfection of the workmanship and the artistry of the finished product are remarkable.

Another form of inlaid enamel is *champlevé,* which is made by cutting grooves in the metal itself—usually bronze or some other metal less precious than gold—to form the design, and filling these grooves with the enamel. A considerable portion of the metal is usually left as a background for the enamel design Many of the valuable old Chinese enamels are champlevé.

In the later Middle Ages artists began to make painted enamels. In this form a coat of enamel is fused over a metal surface, and a design is painted on this background with enamels of various colors. Numerous firings are necessary before the work is completed. Many beautiful plates, bowls, pitchers, salt-cellars, candlesticks, and fine enamel miniatures are to be seen in museums and private collections; and some gorgeous translucent enamel windows have been placed in great cathedrals. Perhaps the finest examples of painted enamels are those produced at Limoges, France, which are distinguished for their elaborate detail.

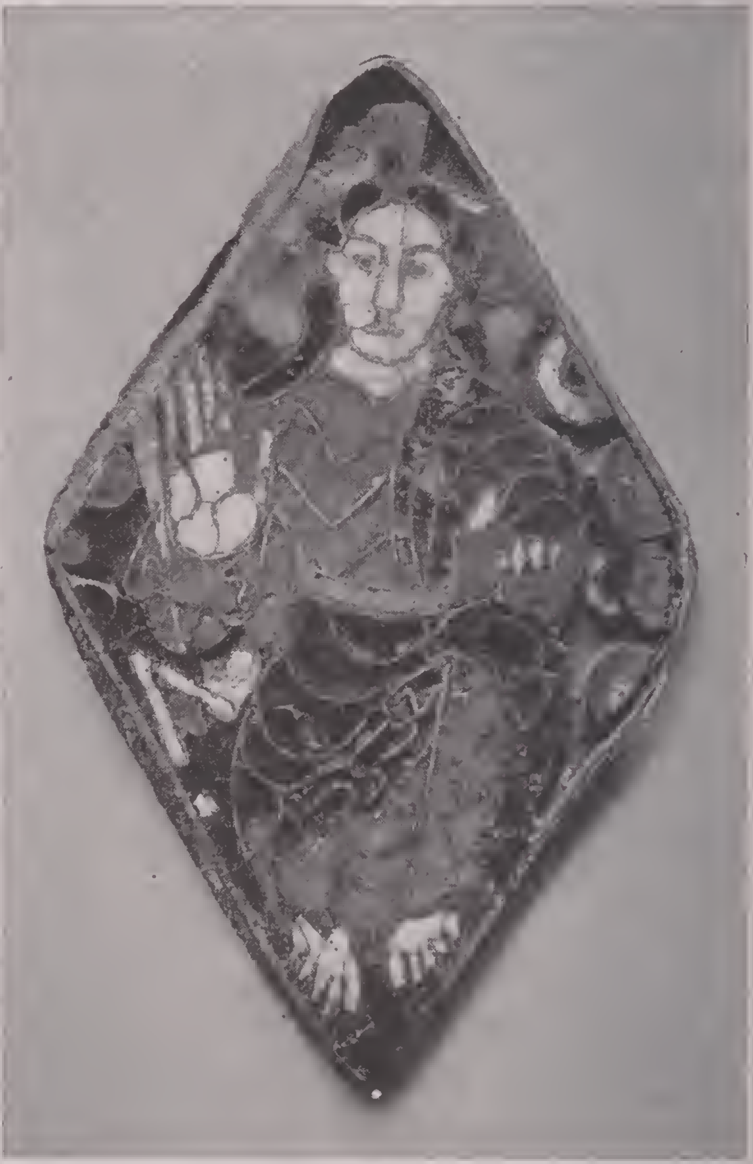
In recent decades the art of enameling has undergone a marked revival. New processes have been invented which produce enamels of a much greater variety of colors than were formerly known, and superior in brilliance and durability.

The most important industrial use of enamel is giving iron and steel utensils shining coats of opaque glass. In the United States alone there are hundreds of factories devoted to producing enameled ware.

Into the making of enamels go many substances—feldspar, quartz, fluorspar, borax, boric acid, soda, potash, saltpeter, clays, ammonium carbonate, stannic acid, and water. Many coloring agents are employed. If the ware is an intense blue, it is probable that cobalt oxide was used to color it; the soft grays which are so popular are generally made with nickel oxide.

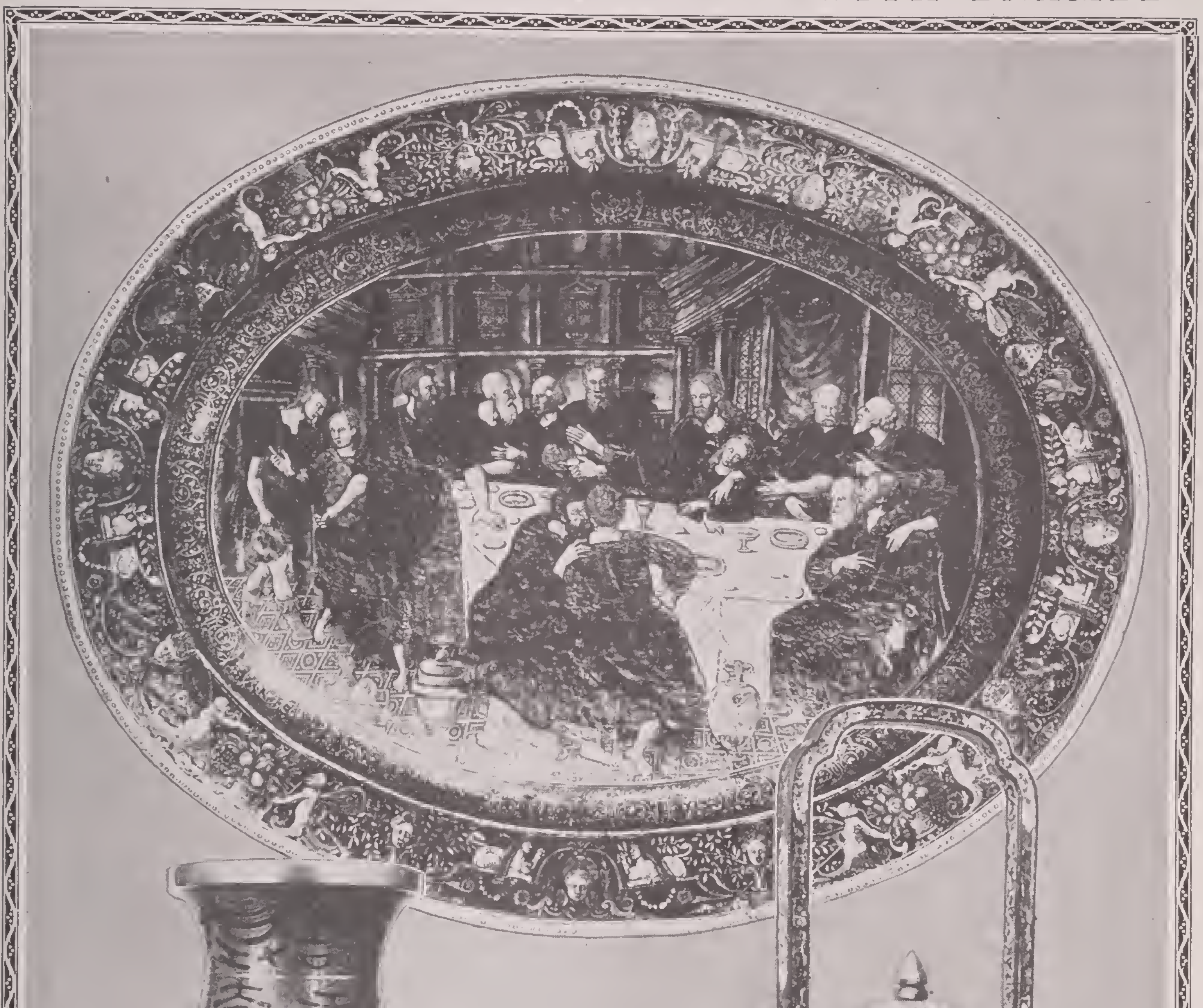
Each manufacturer guards the secret of his ingredients with many precautions. The chemicals are

AN ANCIENT PIECE OF CLOISONNÉ



This ancient plaque shows clearly how cloisonné enameling is made. Metal ridges are set up, and enamel is applied in patches between the ribs. In later work, such as the Japanese vase on the next page, the ridges are almost too fine to be seen.

WHAT TRUE ARTISTS CAN DO WITH ENAMEL



The three specimens of enamel ware above show the many possibilities for varieties of beauty which may be obtained by this process —pictures, complex lines and figures, and ornamented flat surfaces. The platter is a beautiful treatment of 'The Last Supper', done in painted enamel on a copper base, by the French artist, Jean Reymond, in the second half of the 16th century. The jar is a modern specimen of Japanese cloisonné work, while the wine pot with the handle is of enameled copper. The dish and the wine pot are in the South Kensington Museum, London, and the jar in the Metropolitan Museum of Art in New York.

kept in separate bins and are always spoken of by number, never by name. The weighing is done on scales so adjusted that only the person in charge of the work can see them.

After the ingredients are carefully mixed, the "melt" is made in a blast furnace. When the heat has changed them into shining molten glass, a plug is drawn and the vitreous liquid falls hissing into a tank of cold water. With explosive violence the whole mass is torn into shreds, and even the shreds are cracked into innumerable fissures. This "quenching" toughens the enamel body and makes easier the grinding, which is the next process. During the grinding, coloring matter and other ingredients are added.

When the whole mass has been reduced to a very fine powder, it is mixed with water and a little ball clay, and then it is ready to apply. The operator dips the cleaned metal vessel into the liquid enamel or "frit" as it is called, covering every part, and then places it on three metal points to dry before it is taken to the furnace room, where it is fired. From two to four coats are usually applied. "Agateware" and "graniteware" are trade names for varieties of enameled ware.

ENERGY. Did you ever hear of a "perpetual motion machine"? Perhaps not under that name, but such machines are still devised in more or less complicated forms. A perpetual motion machine is a device which continues to run itself without fuel or other outside aid, and yet is able to do work. Thousands of machines of this kind have been proposed by ingenious inventors. One of the simplest is a water-wheel run by water from a pump, the pump itself being driven by the water-wheel; and in addition to the wheel running itself, the inventors of this machine planned to put a pulley and belt on the axle so as to run a mill of some kind.

No such device has ever worked, and yet hundreds and hundreds of gifted mechanics have wasted their lives with such devices. In recent years, a widely advertised experimenter with liquid air described a liquid air engine which, he claimed, was so efficient that he could use it to drive an air-liquefying apparatus, and thus get more liquid air than was needed to run his engine. He could then have this extra liquid air run a second engine, which could run a mill. A machine making its own fuel and yet doing work! Truly a gold mine—if it would only work.

Why do none of these devices work? The student of science tells us that it is against the law of nature that they should work. Nature rules that you cannot get more work out of any device than you put into it. This law, stated in the more exact words of science, is called "the law of the conservation of energy."

Thus, a gasoline engine will not run and do anything unless you supply it with gasoline mixed with air; and this mixture of gasoline and air is simply "stored-up work" or a form of energy. You must put work into the engine to get work out.

The steam engine gets its energy from the burning of coal under the boiler, the heat thus produced being in the steam which expands with force in the cylinder of the engine. Coal is the stored-up work, the form of energy put in, and each pound of coal represents a definite number of foot-pounds of work put into the furnace. The law of the conservation of energy tells us that by no mechanism or device can more than this number of foot-pounds of energy be got out of the engine. As a matter of fact, no boiler and engine is perfect, that is, the useful work got out is less than the work put in. There is some friction in the best of bearings, and there is always loss of heat in boiler and engine, and condenser or exhaust, so that there is always useless work or energy. But the sum of the useful and waste energy is equal to the work put into the plant. We have the chemical energy of the coal transformed in the boiler into the heat energy of the steam; the heat energy of the steam is, in the cylinder of the engine, transformed into the energy of the moving parts of the engine; the energy of the engine is, in the dynamo, transformed into the electrical energy; and, in the motor, the electrical energy is transformed into the rotation energy of the motor to drive some machine. Now the law of the conservation of energy tells us that, in all this process, we are only changing one form of energy into an equal quantity of other forms of energy, some of the transformed energy being useful, but some of it not available for use.

The Sources of Energy

What then can the engineer do with energy? All the engineer can do is to devise machines and processes for turning into useful work as much as possible of the energy that already exists in nature. He cannot make a machine to create energy. The great question for man is to study nature's sources of energy or stored-up work, so that he can transform this into useful work.

What are these sources? Practically, there are only two or three sources of energy that have large value for the industries. These are: (1) the chemical energy of coal and coal oil (petroleum), and, to a less extent, of wood; (2) the energy of water-power of the rivers and streams; (3) the energy of the winds which drive windmills for pumping, etc.

There are other sources of power, but they are in general not large, or are not available. Thus the chemical energy of zinc and sulphuric acid is used in galvanic cells to get electrical energy to ring bells and to run small motors, etc., but the total power in use is relatively small. Even the winds play a small part as a source of power. Water-power in some parts of the world is a large and most valuable source of power, particularly since the discoveries and inventions by which we can transmit energy long distances by electricity. But our largest source of power for manufacturing and transportation is found in coal and oil. Stopping the coal mines stops our industrial life.

But whence came all this "stored-up work" which nature has for man? Why do the rivers flow and furnish power year after year? And whence came the coal and coal oil? And what is the source of the energy of animals? Science tells us that the great source of energy on the earth for man's use is and has been the sun. It is the sun that acts like a great pump to lift by evaporation the water into the clouds to fall as rain and snow, to keep up the flow of rivers. If the sun were to cease sending heat, the rivers would soon dry up, and we could have no water power. But what about coal? Geology tells us that coal is simply the combustible part of trees and plants which grew ages ago on the earth and have been preserved as fuel. But this stored-up work of ancient plants came from the light and heat of the sun. Plants will not grow and wood will not form if there is no sunshine.

But what about the energy of animals, of men, horses, and oxen? Here again we come back to the energy of sunshine; for animals cannot work without food any more than an engine can work without fuel. Indeed, an animal is in a sense a machine for turning the chemical energy of food into muscular energy. But food finally depends upon plants, and plant energy is the transformed energy of sunlight.

This wonderful story of the forces of nature and the transformation and conservation of energy, which is the great principle of our living and working, was discovered about 1840 by Joule, Helmholtz, Kelvin, and other great scientific men of that day. It is often said to be the greatest discovery of science in the 19th century.

ENGINEERING. The skilled engineer of today is not only a builder; he is an expert who can solve the most intricate economic and financial problems, and can forecast the future. Thus, an engineer locating a railway line can tell what route will yield the largest earnings, through his knowledge of the effect of grade and curvature on the cost of haulage and other such details. Before the United States started work on the Panama Canal—the greatest engineering achievement in history—engineers estimated that the cost of digging 100,000,000 cubic yards of rock from the Culebra cut would be 80 cents a yard. When the canal was completed some 15 years later, it was found that they had overestimated by less than two cents a yard!

The increasing complexity of industry makes the expert engineer more and more a necessary factor, not only in industry, but in governmental supervision of industry. The United States Interstate Commerce Commission employed hundreds of engineers to value the country's railways. State public utilities commissions often employ scores of engineers. Enormous projects requiring the services of big engineering staffs for five or ten years are sometimes necessary to supply a great city with water.

The present tendency is for industrial engineering to concentrate in the hands of large firms employing many engineers. Probably 95 per cent of American engineers work on a salary, either for commercial firms, or in city, state, or federal service. In the work of the engineer is included the design and planning of the engineering project, and the supervision of the carrying out of the work. In some cases the engineers contract for the construction of the work. An engineer who gives advice as an expert on engineering work is termed a "consulting engineer." As a consulting engineer is frequently asked to advise on the work of other engineers, he is generally a man who has had considerable experience in his field.

There are four principal divisions of engineering: civil, electrical, mechanical, and mining engineering. "Civil engineering" comprises works in connection with transportation, such as railways, canals, and roads; works which have to do with water, such as public water supply, irrigation, drainage, and sewerage; works of river and harbor improvement; and structural works, such as bridges, buildings, dams, piers, docks, etc. "Electrical engineering" deals with the design, construction, and application of electrical machinery and apparatus. "Mechanical engineering" is the art of machinery design and construction. Mechanical engineering so far underlies engineering of every class, and all kinds of industrial operations, that it can almost be said to sustain the whole fabric of modern civilization. "Mining engineering" includes the work in connection with the exploration for mines and their development. The highest professional skill is required to examine and report on the value of a mine and its probable life.

Each of these divisions includes a large and increasing number of specialized lines, totaling 100 or more. Thus, civil engineering includes railway, hydraulic, structural, sanitary engineering, etc. Mechanical engineering includes steam, gas, automobile, heating and ventilating engineering, etc. Many distinguished engineers, however, do not specialize at all, but act as technical executives, directing the work of various engineers to complete a great construction work or conduct a huge manufacturing or mining industry.

Other important branches are military engineering and marine engineering. "Marine engineering" embraces the building and operating of ships and naval accessories, the construction and planting of torpedoes and mines, etc. "Military engineering" includes the construction of fortifications, trenches, military bridges, pontoons, army telegraph and telephone systems, etc. The United States army and most of the other armies of the world maintain a special engineer corps (*see* Army).

Among the most notable engineering works of remote antiquity are the Pyramids of Egypt (*see* Architecture; Pyramids). The Hanging Gardens of Babylon were one of the wonders of the world; and the harbors and temples of ancient Greece testify to no little engineering skill. The theaters, temples, baths, aqueducts, roads, bridges, and drainage works of ancient Rome vie in extent and magnificence with many celebrated modern works. Other engineering feats of former days are the Dutch canals and embankments for inland navigation and for protecting the low lands from the sea, and the cathedrals and castles of medieval Europe.

Notwithstanding the large number of students of engineering in our colleges, the demand for technically trained men is so large and so varied and so many new fields of technical work are being opened, that few engineers of worth fail to find profitable employment. For a youth fond of mechanical and construction work and with a taste for mathematics and physics, engineering offers a fine field for attainment and service to mankind. Energy, sound practical judgment, and a painstaking accurate temperament are essential. For the degree of C.E. (Civil Engineer) or M.E. (Mechanical Engineer) most technical and engineering schools of repute require four years of undergraduate work, about three years of successful experience and one year of graduate work. One can scarcely hope to be trusted with important engineering works before he is a man of maturity, with years of technical study and practical experience.

MOTHER-LAND *of the* WORLD'S GREATEST EMPIRE

This little world,
This precious stone set in the silver sea,
Which serves it in the office of a wall,
Or as a moat defensive to a house
Against the envy of less happy lands!—Shakespeare.

ENGLAND. In the latitude of Labrador, off the Atlantic coast of Europe, lie the British Isles, of which the largest—Great Britain—is divided into Scotland, England, and Wales. England, the chief of these divisions, forms a triangle whose greatest side is only 425 miles. Along the western side of the island are low mountains, especially in Wales; and in northern Scotland the mountains are quite rugged. But the Cheviot Hills, which separate England from Scotland, and the Pennine Range, which runs southward into England and is called its "backbone," seldom rise above 2,500 feet. In the southwest, the Mendip Hills (highest 1,067 feet), the Cotswold (1,100 feet), and Dartmoor (2,039 feet), though containing tracts of wild and desolate country, can nowhere be considered mountainous.

Extent.—North to south, 354 miles; east to west, 210 miles; coast line more than 2,000 miles. Area, 50,874 square miles. Population, about 35,000,000.
Physical Features.—Low rolling country, broken by the Pennine Range in the north (highest point, Sca Fell, 3,210 feet), and the Downs and Devon hills in the south and southwest; Cambrian Mountains in Wales (highest point, Snowdon, 3,560 feet). Principal rivers: Tyne, Humber (Derwent, Swale, Wharfe, Aire, Don, and Trent); Welland, Nen, and Ouse; and Wye; Mersey, Thames; Severn. Climate, mild with little variation.
Chief Products.—Wheat, barley, oats, hay and forage crops, potatoes, and fruit; cattle, sheep, hogs, horses, and dairy products; herring, haddock, cod, and other fish; coal, iron, and clay; textiles, iron and steel manufactures (including cutlery and machinery), clothing, pottery, ships and boats.
Principal Cities.—Greater London (more than 7,000,000), Liverpool (775,000), Manchester (740,000), Birmingham (860,000), Sheffield (475,000), Leeds (430,000).

In the main, England is a fertile and well-watered land, with a good climate, neither very cold in winter nor very warm in summer. The numerous navigable rivers afford excellent harbors, and there is a great wealth of minerals—tin in the southwest, immense coal-fields in the center and north, and some iron. Nowhere is the sea more than 100 miles distant—protecting the island from enemy attacks and inviting the inhabitants to voyage forth for fish and in commerce.

Today this tiny island country—only a little bigger than Cuba, a fourth the size of France, a little larger than Newfoundland, or about the same size as the state of Illinois or New York—claims as loyal subjects and fellow citizens one-fourth of all the people known to be in the wide world—an empire "on which the sun never sets"! War and commerce, the explorer's lonely courage, and the colonist's hardy enterprise, have all contributed to its up-building. As a British poet has well said:

Time, and the ocean, and some fostering star,
In high cabal have made us what we are,
Who stretch one hand to Huron's bearded pines,
And one on Kashmir's snowy shoulder lay,
And round the streaming of whose raiment shines
The iris of the Australasian spray.
For waters have connived at our designs,
And winds have plotted with us—and behold,
Kingdom on kingdom, sway on oversway,
Dominion fold in fold!

But please note that we do not say it "governs" one-fourth of all the people living in the world. It permits the people who fly its flag—with minor exceptions—to govern themselves; and that is why, on the whole, it keeps their loyalty and affection. The only countries where it has lost this loyalty—as in Ireland, Egypt, and India—are those where the people have failed to unite on how they want to be governed; and the only country where it had to take down its flag altogether was the Thirteen American Colonies, which declared their independence and became the United States when a stupid and obstinate king, in the first stages of insanity, would not let the colonies govern themselves.

It was because England lost the American Colonies that she never again tried to "rule" her English speaking dependencies, but let them rule themselves. England's history has been full of terrible blunders, but she has always learned from a blunder not to commit the same mistake twice.

Is England great because of her geography, or her soul? Did she conquer the physical facts around her, or was she made by them?

You can't conquer physical facts, any more than you can put your finger in the fire and not get burned. Fire burns and you can't change that fact; but you can use it and make the fire to boil kettles and run steam engines and steamships and factory plants. That is the secret of England's greatness. She used the facts of her history and environment to build up her country's power. Let us see what these facts are that England has harnessed to ride on, like a great steed, to her present wonderful empire. Shut your eyes and pretend you are dreaming, away back before the days Christ walked in Galilee!

Phoenician merchants from the Mediterranean come beating over the waves in long ships rowed by slaves chained to the oars—through the narrow Strait of Gibraltar, up the Spanish coast, and across to a little unknown land only 21 miles across from Gaul (modern France). They find a strange wild blue-eyed people, dressed in hides, with shields of skin so thick and hard an arrow could scarcely penetrate. These people wore leather sandals and leggings, and dyed or tattooed their bodies with a blue weed called "woad." They belonged to the race which we call Celts (Kelts). They themselves were styled "Britons," and the island "Britain."

What the Phoenicians wanted especially from Britain was its tin, so necessary in making the bronze tools and weapons used in that long ago time. Greek

ANCIENT TRAVELERS OF OLD BRITISH ROADS

When the Romans held Britain they left their mark, according to their custom, in well-built roads, many of which are still highways of travel. Here, with the magic of his brush, the artist has brought back upon one of these old thoroughfares the historic figures who traveled over it in the past—the Briton Chieftain with his coat of skins, the Roman legionary, the Saxon invader, the Dane with his horned helmet, and, in the distance, the Norman knight, the last of England's conquerors.

merchants from Marseilles (in southern Gaul) also visited Britain, and finally the Romans learned of it.

The Roman Conquest of Britain

Julius Caesar (55 and 54 B.C.) was the first Roman to lead an expedition to these shores, and he did so because the Britons would come dancing across the narrow waters of the English Channel in cockleshell skiffs and help the Gauls, whom Caesar was then conquering. His first landing was where the white cliffs near Dover may be seen from afar. On his second expedition he penetrated up the Thames to a muddy village where the Celts lived in thatch-roofed cabins, surrounded by dank swamps and thick forests, near what is now London. But it was not until nearly 100 years after Caesar (43 A.D.) that Emperor Claudius sent an expedition which began the real conquest of the island. Only the southern half was really conquered and organized as a Roman province. To keep back the savage Picts and Scots of the north, the emperor Hadrian (121 A.D.) built a great wall of stone across the narrow neck of the island.

KINGS AND QUEENS OF ENGLAND

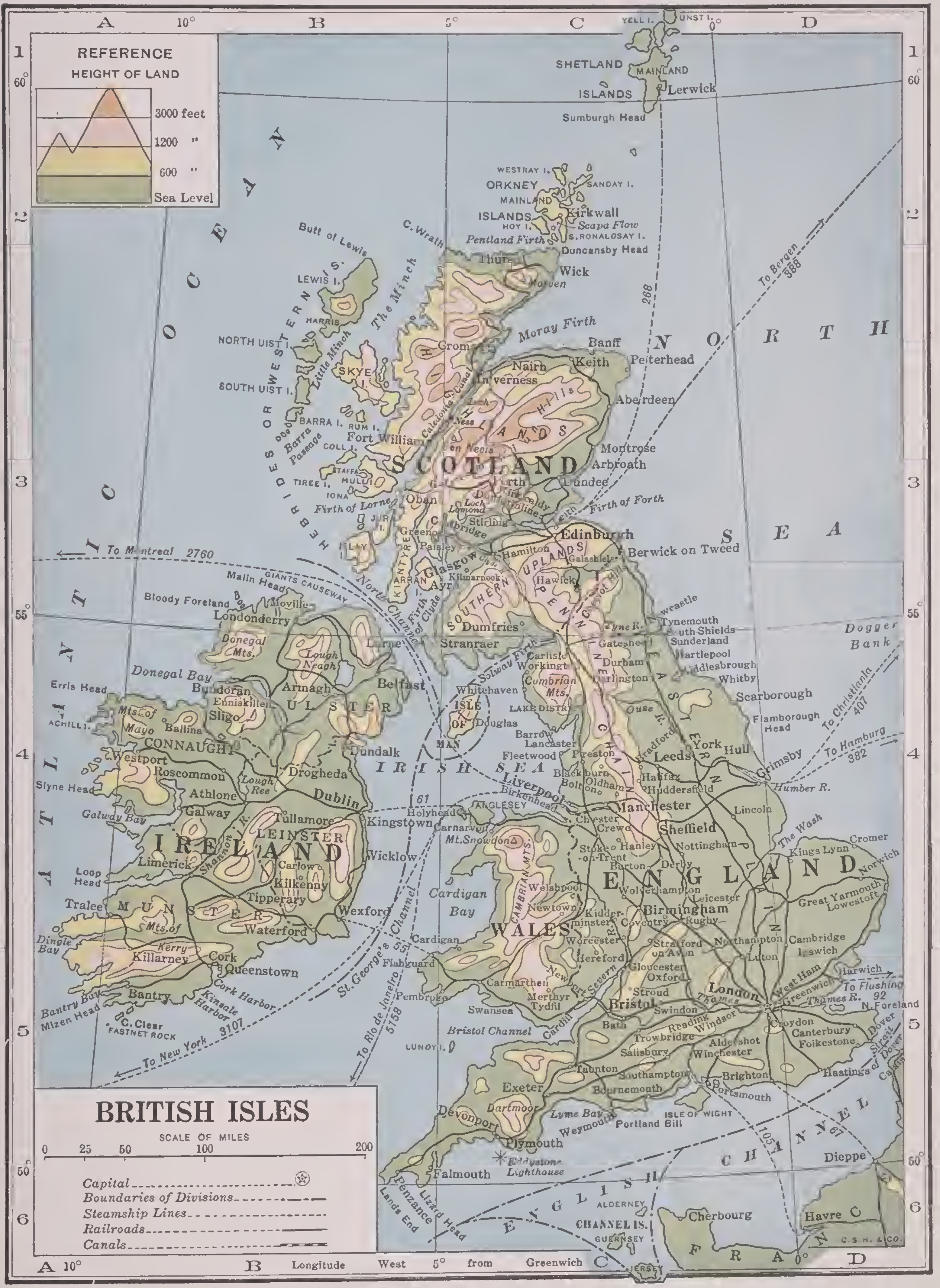
SAXON LINE			
802–839.	Egbert.	925–940.	Athelstan.
839–858.	Ethelwulf.	940–946.	Edmund I.
858–860.	Ethelbald.	946–955.	Edred.
860–866.	Ethelbert.	955–959.	Edwy.
866–871.	Ethelred.	959–975.	Edgar.
871–899.	Alfred the Great.	975–979.	Edward the Martyr.
899–925.	Edward the Elder.	979–1016.	Ethelred "the Unready."
DANISH LINE			
1016–1035.	Cnut.	1035–1040.	Harold.
1040–1042.	Hardicanute.		
SAXON LINE			
1042–1066.	Edward the Confessor.	1066.	Harold II.
NORMAN LINE			
1066–1087.	William the Conqueror.	1100–1135.	Henry I.
1087–1100.	William II.	1135–1154.	Stephen.
PLANTAGENET LINE			
1154–1189.	Henry II.	1272–1307.	Edward I.
1189–1199.	Richard I.	1307–1327.	Edward II.
1199–1216.	John.	1327–1377.	Edward III.
1216–1272.	Henry III.	1377–1399.	Richard II.
HOUSE OF LANCASTER			
1399–1413.	Henry IV.	1413–1422.	Henry V.
1422–1461.	Henry VI.		
HOUSE OF YORK			
1461–1483.	Edward IV.	1483.	Edward V.
1483–1485.	Richard III.		
TUDOR LINE			
1485–1509.	Henry VII.	1547–1553.	Edward VI.
1509–1547.	Henry VIII.	1553–1558.	Mary.
1558–1603.	Elizabeth.		
STUART LINE			
1603–1625.	James I.	1625–1649.	Charles I.
1649–1660.	Commonwealth.		
1660–1685.	Charles II.	1689–1702.	William III.
1685–1688.	James II.	1702–1714.	Anne.
HANOVERIAN LINE			
1714–1727.	George I.	1820–1830.	George IV.
1727–1760.	George II.	1830–1837.	William IV.
1760–1820.	George III.	1837–1901.	Victoria.
1901–1910.	Edward VII.		
HOUSE OF WINDSOR			
1910– .	George V.		

South of the great wall, the Romans built numerous roads and some 56 walled cities. They taught the Britons how to plant oats and barley and wheat, and the upper classes became Romanized. For more than 300 years the Britons were under the civilizing influence of the Romans. In this time obscure soldiers and traders introduced the Christian religion, and here and there arose its chapels. Then in 410 A.D. the last of the Roman legions withdrew and the Britons were left to rule themselves, for mighty Rome was now at hand grapples with hordes of Teutonic barbarians.

Left to themselves the Britons found they had forgotten how to fight, and were unable to unite under a single government. When their old enemies, the Picts and Scots, began to attack them, they were in despair. In a letter called 'The Groans of the Britons' they wrote for aid to a Roman general, saying: "The barbarians drive us to the sea; the sea throws us back on the barbarians. Thus two modes of death await us; we are either slain or drowned." From the Continent, too, came heathen sea-rovers of the German tribes—Angles and Jutes and Saxons—beginning their conquests about 449 A.D. In the course of 250 years the newcomers possessed themselves of the whole of "Angleland" or "England" (now first so named from the invading Angles).

Everywhere, except among the Celts in Wales and Scotland, the Latin language, Roman civilization, and the Christian religion disappeared. A Teutonic speech and Teutonic institutions—brought with them by the invaders—took their places. Christianity was soon introduced again, chiefly by the monk Augustine and his companions, who landed in Kent in the year 597. Two centuries later (827 A.D.)—just about 1,000 years ago—the scattered English kingdoms were for the first time united into a single kingdom, soon to be made illustrious by the glorious name of Alfred (*see* Alfred the Great). Danish raids and settlements troubled the land for over a century, but Alfred checked their advance, and his successors reconquered the "Danelaw" in which these Northmen were settled. In the 11th century there was a second wave of Danish conquest, and under Canute and his two sons the whole of England was for a quarter of a century under Danish rule (*see* Canute). But presently the old Saxon line was restored in Edward the Confessor, so the Danish invasions merely strengthened the liberty-loving strain in the English people.

Then in 1066 came the Norman Conquest. William of Normandy, claiming that he had been promised the throne of England, defeated and killed the elected king Harold, at the battle of Hastings, and conquered the



BRITISH ISLES

country (*see* William, Kings of England). Half the land was divided among William's followers. Everyone who received or kept land directly from the king (the "barons") had to swear allegiance to him and supply him with soldiers. Feudalism prevailed (*see* Feudal System). In the next 150 years the Normans became English; the conquered absorbed the conquerors. The old laws and customs and language of the Anglo-Saxon triumphed over the Norman-French, though they were considerably changed. By that time the Plantagenet kings, descended from the Conqueror's granddaughter, were reigning. The kings never made new laws or managed to get money in new ways without consulting the Council of the leading men—a Saxon fashion. When King John tried to do otherwise, the powerful barons made him set his seal to Magna Carta (1215), which meant that no one, not even the king, had a right to break the law or change it without the Council's consent. Then the Council became Parliament. Members elected to represent the bigger towns and the counties or "shires" were summoned to attend it, as well as the greater barons, whose right to attend was already established by custom. This change was given its final shape by Edward I (1295). Soon after that, Parliament definitely divided into the House of Commons and the House of Lords (*see* Parliament). The long Hundred Years' War with France (1337–1453) and the Wars of the Roses (1455–85) are described in separate articles.

THE LORD PROTECTOR AND HIS DARING ADMIRAL

Of all the long line of men who, by their skill and daring, made England mistress of the sea, Robert Blake, who is here seen receiving his commission from Oliver Cromwell, in 1649, as commander of the Parliamentary fleet, is one of the most striking and picturesque. On one occasion with 20 ships he defeated the great Dutch Admiral Tromp with 45. On another, with only 40 ships, half of which were useless for want of men, he fought Tromp who had 80 fighting vessels and 10 fire-ships and withdrew undefeated; then later defeated Tromp in a three-day battle. His last and greatest feat was the destruction in 1657 of the Spanish treasure fleet which each year carried the gold and silver of the Americas to Spain. The fleet lay in the Bay of Santa Cruz (Canary Islands) under the protection of formidable forts with guns, and Lord Clarendon says of the feat: "It was so incredible that all men who knew the place wondered that any sober man would have undertaken it."

When Columbus in 1492 discovered America for Spain, the Tudor king Henry VII sat on the English throne. This nation of sea-rovers, with harbors opening on the Channel, on the Humber, on the Thames, on the Bristol Channel, with the love of the sea and the love of freedom in their very souls—took to the sea like fish to water and seized upon the opportunities offered by the New World. England had then a population less than New York City today. London, although a great mart for traders, was little more than a mud-hole sprawling on both sides of the Thames; Liverpool was a village; Bristol was a good-sized seafaring town of perhaps 8,000 to 10,000 people.

In 1588 something else happened in Europe to change this little island's destiny. England defeated the great Spanish Armada (*see* Armada, Spanish) through the leadership of those very sea-rovers who already in the person of Sir Francis Drake, had plowed a silver furrow around the oceans of the world.

This left England mistress of the seas. The sea was her wall against attacks and wars which devastated continental Europe. Her greatness lay over the paths of the sea; and in the souls of her sons was the passion of a race that had learned to fight and die for liberty.

But wars and religious persecutions on the Continent were driving the suffering peoples abroad; and to many of these under the influence of her own Reformation, England threw wide her gates as a port of refuge. Flemings had already come from the Netherlands and taught the English the arts of weaving, lace-making, metal work, and watch-making. Exiled French Huguenots carried to England the secrets of French manufactures and hatred of Louis XIV. Jews from as far East as Constantinople reëstablished themselves in England in the days of Cromwell, and gradually made London a center of world banking and finance. East began to meet West, not in Alexandria (Egypt) nor in Constantinople, which had fallen before the Turk, but in London, always protected from attack by the sea. Still the migrations of oppressed peoples kept up—artisans, bankers, traders, sailors of the deep seas from every quarter of the globe. Protection from war and attack, love of liberty, freedom guaranteed by the law to all subjects—these were the magnets that drew the peoples of the earth to the shores of the snug little island, whether she was ruled by semi-despotic Tudor and Stuart kings, by a military republic or "Commonwealth" as in the day of Cromwell, or under strictly limited kings imported from Germany, as under the Hanoverian Georges after the year 1714. Thus England became the great mart of the world's commerce—the place to which all nations might send what they had to sell and take away what they wished to buy. From numbering 7,000,000 in Queen Elizabeth's day—when the nation was still struggling for freedom of worship and the right to self-rule—England by 1900 had grown to be a nation numbering almost 35,000,000. She had become the great middleman of the world's commerce.

THE CHIEF CASTLE OF ENGLAND'S KINGS AND QUEENS

This is Windsor Castle, on the Thames, one of the many residences of England's kings and queens. Its oldest part dates from the time of Edward III. If one could make out whether that flag on the turret of the famous Round Tower is the royal standard, one could say whether their majesties were "at home"; for the royal standard is always raised when the sovereign is occupying the castle.

Mistress of the seas from the time she defeated the Spanish Armada in 1588. England soon had yet greater need to be the strongest naval power in the world. She now (1763) wrested from France a colonial empire in Canada and India (*see* French and Indian War) to add to her existing Thirteen Colonies, and shortly afterwards laid the foundations by discovery and settlement of her wide domains in Australia and New Zealand. It was her dominance of the seas as shown at Trafalgar (1805) that defeated Napoleon far more than the battle of Waterloo (1815). No wonder the embittered and defeated French emperor called her "a nation of shopkeepers." She was and is, but in the best and noblest sense of that term.

Then began in England that tremendous change which we call the Industrial Revolution, when Englishmen invented machines that enormously increased production and changed the economic and social face of the world. (*See* Industrial Revolution).

BEAUTIFUL HAMPTON COURT

Here we are at the gateway of Hampton Court Palace, one of the finest examples of Tudor brick architecture. It was built by Cardinal Wolsey and so attracted Henry VIII, who had an unpleasant way of taking whatever he wanted, that the Cardinal thought it wise to make him a present of it. It is the largest royal palace in Great Britain. Here was held the Hampton Court Conference in 1604, which preceded James I's persecution of the Puritans.

But as her people turned more and more to factory production and world trade, England ceased to be self-supporting; her fields and herds could no longer

TYPICAL SCENES OF THE ENGLISH COUNTRYSIDE

feed her rapidly growing population. Food must be brought from afar, so it was more necessary than ever that her navy should control the seas against hostile attacks. It has sometimes been said that England would starve if the seas were closed to her for only three weeks; but this is an exaggeration as was shown by the failure of the submarine blockade in the World War. Nevertheless, from about 1800 England was a food-importing instead of a food-exporting country. After long resistance from the Tory landlord class, famine in Ireland forced their hands and free trade in food was established in 1846, through the repeal of what were called the Corn Laws. At the same time England became a free-trade nation in other goods also. This brought volumes of raw material to her ports and marts, and she became the greatest industrial nation of the world. Her factories, belching smoke and flame from a million smokestacks, manufactured the raw cotton, raw iron, wool, and other raw materials of the world into textiles, steel, food products, machinery, cutlery, cloths for the buyers of all nations.

When the poet James Thomson wrote of English villages "embosomed soft in trees," he must have had such a view in mind as you see in the upper picture. Below you see a typical English cottage home, with its thatched roof.

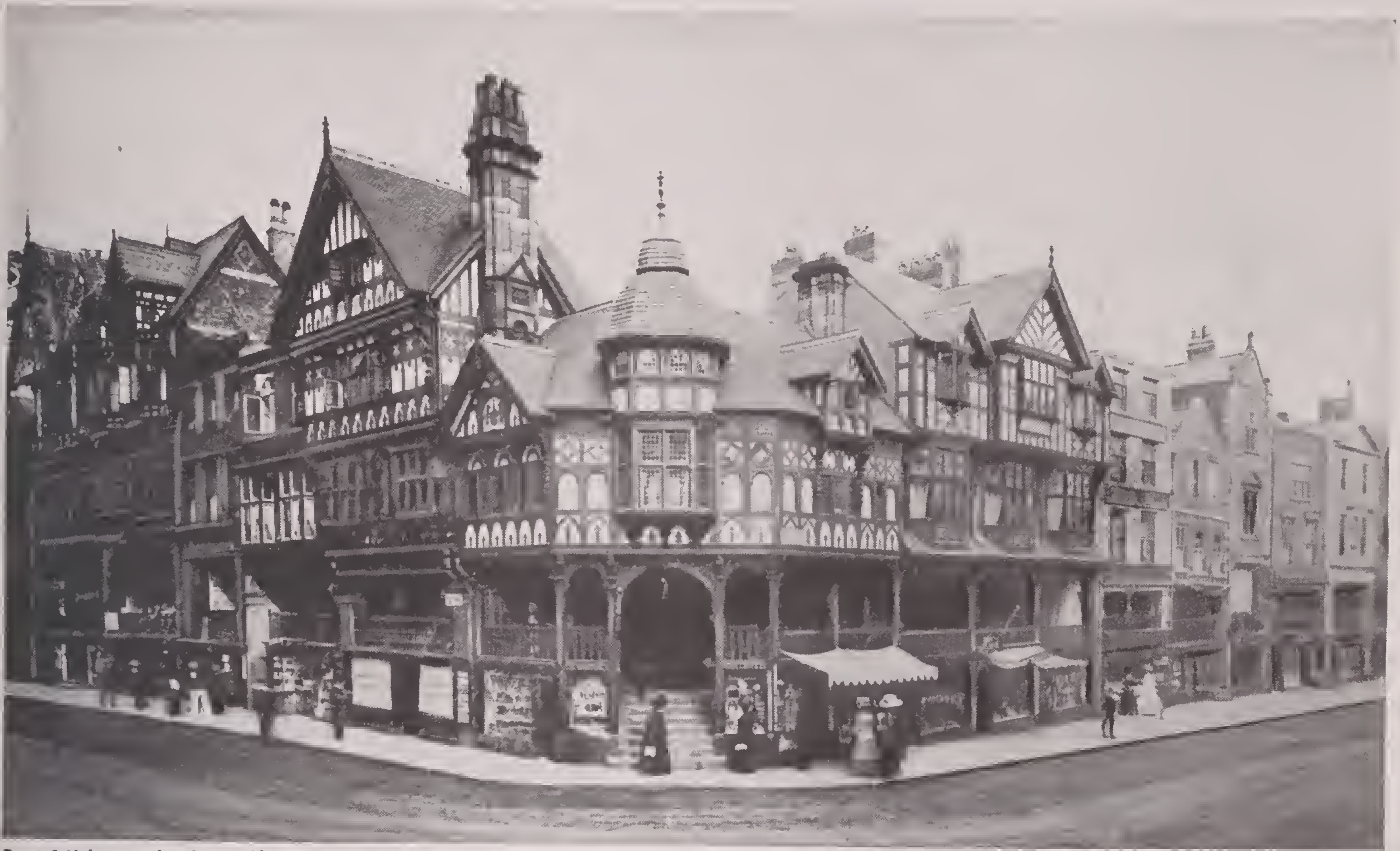
Traders coming to British ports knew, moreover, that they would be paid in gold sovereigns that would pass for full value everywhere. This helped to make England the great banker of the world. Gold and silver from many lands poured into her marts, and England's vast gold reserve became the envy of less fortunate countries.

But a world banker to be trusted must be honest. His word must be as good as his bond; a nod of his head must be as good as a gold coin. Soon after England became mistress

Two Thousand Years of English History in Outline

B.C.	
55–54.	Julius Caesar invades Britain.
A.D.	
43–410.	Romans rule Britain. Insurrection of Queen Boadicea put down (61 A.D.).
449–700.	***Anglo-Saxons conquer the land*** ("Angle-land" or England).
597.	St. Augustine reintroduces Christianity.
827.	England united under one king (Egbert of Wessex).
878.	Alfred checks the raids of the Danes.
1016–1042.	Danes rule England (Canute).
1066.	***Duke William of Normandy conquers England;*** Feudalism introduced.
1154–1189.	Henry II (Plantagenet) rules over England, and holds Normandy, Anjou, Aquitaine, etc., in France. Conquest of ***Ireland*** begun.
1199–1216.	John loses Normandy and Anjou; forced to grant ***Magna Carta*** (1215).
1282.	Edward I conquers ***Wales;*** calls Model Parliament (1295).
1314.	Edward II defeated by Scots at Bannockburn; attempt to conquer ***Scotland*** fails.
1337–1453.	***Hundred Years' War with France.*** Victories at Crécy (1346), Poitiers (1356), Agincourt (1415); Henry V king of France as well as England, 1420; ***Joan of Arc*** turns the tide against the English (1429–31).
1381.	Revolt of peasants under John Ball and Wat Tyler.
1399.	Richard II overthrown by Henry IV (House of Lancaster).
1450.	Jack Cade's Rebellion.
1455–1485.	***Wars of the Roses*** (red rose of Lancaster against the white rose of York).
1485.	Henry VII (Tudor) defeats Richard III (York) at Bosworth and ends the war. Strong monarchy established.
1534.	***Henry VIII breaks the ties which linked the English church to Rome.***
1553–1558.	Mary restores the Roman Catholic church.
1558–1601.	***Elizabeth establishes the Church of England;*** great development in industry, sea power, and literature (Shakespeare).
1588.	***Spanish Armada defeated.***
1603.	***Scotland united with England*** in personal union under ***James I*** (Stuart).
1607.	First permanent English colony in America settled at Jamestown, Va.
1620.	Settlement of Plymouth (and Boston, 1630), following persecution of Puritans in England.
1642–1649.	***Civil War between Parliament and King Charles I,*** over religion and rights of Parliament; ***Charles beheaded, 1649;*** England becomes a Commonwealth (republic).
1653–1659.	***Oliver Cromwell*** rules England, Scotland, and Ireland as "Lord Protector."
1660.	***Stuart line restored in Charles II.***
1688–1689.	***"Glorious Revolution"*** drives James II from the throne and establishes the Protestant succession.
1701–1713.	***The War of the Spanish Succession.*** Preserves the Protestant succession for England, curbs the power of France, and paves the way for the increase of England's colonial empire (Marlborough's victory at Blenheim, 1704). Peace of Utrecht, 1713.
1707.	***Union of England and Scotland*** into the kingdom of ***Great Britain.***
1714.	***Hanoverian line*** succeeds to the throne in George I. Supremacy of Parliament firmly established; gradual growth of ***cabinet government.***
1745.	Rebellion of Stuart adherents ("Jacobites") in Scotland and England put down.
1755–1763.	***War with France*** (part of Seven Years' War on Continent; in America called French and Indian War) ***founds the British Empire. Canada*** conquered; British supremacy in ***India.***
1760.	Accession of ***George III:*** attempt to rule arbitrarily by means of corrupt party known as "the King's Friends."
1764.	***Industrial Revolution*** begins with Hargreaves' invention of the spinning jenny.
1775–1783.	***Thirteen American Colonies revolt*** and establish their independence with the aid of France.
1788.	British begin to colonize ***Australia.***
1793–1815.	***Wars with Revolutionary France and Napoleon*** (victory of Nelson at Trafalgar, 1805; of Wellington at Waterloo, 1815).
1801.	Irish Parliament abolished and Irish members added to Parliament of Great Britain (thenceforth styled ***United Kingdom of Great Britain and Ireland***).
1806.	Cape Colony conquered from the Dutch; beginning of ***British South Africa.***
1829.	Catholics readmitted to Parliament.
1832.	***Great Parliamentary Reform Act*** gives control to the middle class. A large number of social and political reforms follow (***slavery abolished,*** 1833; numerous factory laws, etc.).
1846.	"Corn laws" repealed and ***free trade*** established.
1853–1856.	Crimean War with Russia in defense of Turkey.
1867.	***Second Parliamentary Reform Act*** extends the vote to workingmen. Beginning of ***democratic rule*** in Great Britain.
1870.	Beginning of ***Irish Home Rule*** agitation.
1882.	British occupation of ***Egypt*** begun.
1899–1902.	***Boer War*** in South Africa. (Formation of Union of South Africa, 1909.)
1911.	Power of ***House of Lords*** limited.
1914–1918.	***Great World War.*** Great Britain and Ireland mobilized 8,000,000 men; 706,726 slain; 2,391,287 wounded, missing, and prisoners. (For additions to the British Empire due to the War, ***see*** article World War of 1914–18.)
1918.	Votes given to women (6,000,000 added to voting list).

PICTURESQUE CHESTER AND ITS CURIOUS "ROWS"



In addition to its beautiful old timbered houses, Chester is interesting on account of what are known as the "Rows,"—continuous galleries or arcades under and over which the houses lining the street project. Another interesting thing about Chester is that it is the only walled city in England—that is to say, in which the walls in large part are still standing. Numerous Roman remains may here be seen, for the city dates from 60 A.D., and the very name Chester is derived from the Latin castra, "camp."

of the seas, in Queen Elizabeth's time, the Lords of Trade in London began holding weekly meetings to establish honest customs in all trade. The use of false trade names, selling shoddy for wool, "fake" furs, cotton scraps for felting,—such practices were considered crimes and severely punished Tradesmen who were guilty of them were placed in the stocks with their feet and neck in wooden hobbles, exposed to the jeers of the market place. In an English boys' school today, in the schoolroom or on the playground, they will pardon almost any fault in a boy except two—lying and cheating. If he lies or cheats he will be expelled and never received in that school again; nor will the other boys' parents ever receive him in their homes. It is much the same with the "grown-ups." They will forgive a foolish young nobleman being a spendthrift or getting into scrapes; but if he cheats at cards, or in horse races, or in yacht races, he is excluded from good society forever, and it will take a generation to efface the blemish from his name. All this is part of the inheritance from the days of "Good Queen Bess," when the Lords of Trade built up rules, and customs stronger than rules, that make England the trusted tradesman and banker of the world.

Let us look back here at the factors that have helped to build up England's greatness:

A capable nation growing from the union of Celt, Anglo-Saxon, Norman, Dane, and other elements.

An island position with the sea to protect it, leading it on to mastery of the oceans and the world's greatest merchant fleet.

Political liberty and self-government, and after that, toleration and hospitality for all races and all religions.

The first great manufacturing nation of the world, as a result of the Industrial Revolution.

A market for goods of all kinds, the world's great shopkeeper.

A sound financial system, on the gold standard, making it the banker of the world, with an established reputation for honesty and integrity.

A Vacation Visit to England Today

Now let us look a little more closely at the historic land itself. The most densely populated country in Europe, and one of the most thickly settled in the world, with an average of about 618 people to the square mile, England is still, especially in the southern part, like a garden. About 77 per cent of the land is capable of being put under the plow and cultivated. Its great forests have long since disappeared, for the most part, so that England is today forced to depend upon Canada, the United States, and other lands for her timber. But there are still tracts of open moor and fenland that stretch for miles; and here and there are great parks and patches of ancient woodland, where the stately deer peep forth fearlessly as in the days of Robin Hood. Richmond Park, on the Thames just west of London, covers 2,255 acres of magnificent forest and broad meadow; while Epping Forest, another royal deer forest, a dozen miles northeast of London, has an extent of more than 5,000 acres, and is also in the fullest sense a people's playground. The great ducal estates which dot the "midlands" especially, though not so freely open to the public, help to give England an air of spaciousness.

The Canadian or American who visits England will probably land at Liverpool, one of the world's greatest commercial cities. At its long gray docks he will see ships from Africa and Australia, from China, from India, and from South America—from every great port in the civilized world (*see* Liverpool). If it is summer, the traveler will want to see something of the country before going to London, and will turn aside perhaps to visit quaint old Chester on the River Dee, near the border of Wales. Once a Roman camp, as its name tells us (for Chester comes from the Latin *castra*, meaning camp), its medieval walls follow on three sides the line of the old Roman walls; while its queer shops and old timber-built houses with projecting upper stories make it one of the most picturesque of English towns.

In Manchester—like Liverpool a part of Lancashire—we reach the metropolis of the great cotton industry. Through its huge ship canal, which connects the city with the Mersey and Liverpool, making Manchester practically a seaport, come steamers laden with bales of raw cotton, chiefly from the United States, to be sent on to Oldham, Bolton, Preston, and other neighboring towns to be spun and woven into cotton goods. Why should the Lancashire region be given over so largely to the cotton manufacture? The answer is to be found partly in its moist climate—the wettest in all England—which is particularly favorable to cotton spinning; and partly in the great coal fields that lie on either flank of the nearby Pennine Range.

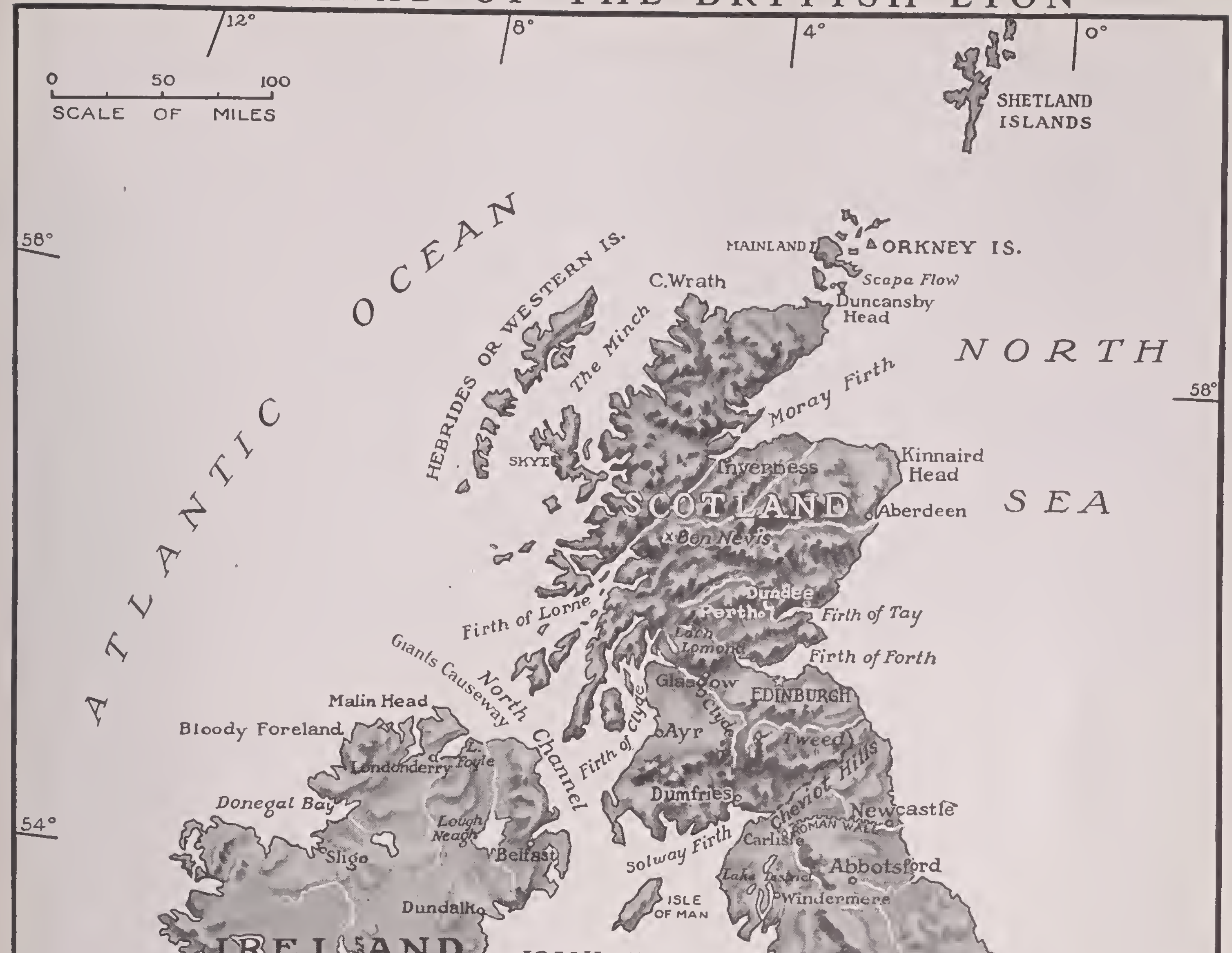
IN THE LAND OF THE LAKE POETS

Who wouldn't be a poet amid scenery like this? Here we are in northwestern England, on the borders of Lake Windermere, made famous by the School of the Lake Poets, of which Wordsworth was the founder and inspiration. Outside of London and Edinburgh no part of the British islands is so identified with distinguished names in English literature as this region, in which are situated all the principal English lakes.

If you were to fly over England in an airplane, you would see a vast smoky district stretching from Cardiff in Wales to the River Tyne on the northeast coast, and on the west coast to Glasgow and the Clyde district of south Scotland. Blacker, smokier, more crowded with people, exchanges, railroads, banks, and warehouses, than anywhere else in this "Black Country," would appear the district about Manchester; for here are the richest coal beds, and therefore the greatest factories. Along the Trent River in Staffordshire are great pottery works; and here lie the "Five Towns" Arnold Bennett has made famous through his novels.

Not far away, where iron and coal are found close together, is Birmingham, in the northwest corner of Warwickshire—the greatest metal-manufacturing cen-

THE HEAD OF THE BRITISH LION



A few minutes' study of this map will make clear some of the geographical factors that have helped shape English history. First and foremost, the British Isles are surrounded by the sea, which serves as a barrier to shut out enemies and as a highway for commerce. The sunken coastline provides many good harbors, and the tidal rivers provide easy communication with the interior. The smallness of the country—it is less than half as large as Texas—has impelled its crowded people to cross the seas and found new colonies, until today the British flag waves over a quarter of the earth's land surface. Observe that the chief highland areas are in Wales and Scotland. This explains why the Welsh and Scotch have retained the old Celtic racial character in far greater degree than the lowland people, who became fused with their Teutonic and Norman conquerors. The Irish, too, have remained predominantly Celtic, thanks to the water barrier that separates Ireland from its sister island. The position of the islands with reference to continental Europe gives them exceptional commercial advantages. They command the English Channel, which is the chief maritime artery of European commerce, and thus have easy access to the chief European ports.

ter in England and perhaps in the world. Sheffield, 75 miles to the north, in the corner of Yorkshire, has similar advantages, making it the world's center for cutlery. Today, to be sure, there is no longer enough iron in England to supply the needs of these industries; but England has the coal and she says to Spain and Sweden, "Give me iron ores and I'll give you textiles and other manufactures." In this same humming region are others of England's great industrial cities—Nottingham, known for its laces; Huddersfield, Halifax, and Bradford, with their world-renowned woolen mills; Leeds, the leading cloth market of Europe, and also a city where heavy machinery of all kinds is turned out. If shipping and trade constitute one leg by which England strides to greatness, manufacturing is certainly the other.

Among the Lakes where the Poets Lived

But tiring of this bustle and smoke of factories, let us tarry a bit in the beautiful Lake District of Westmoreland and Cumberland, just north of Lancashire. Here, in the northwest of England, is the country made famous by Wordsworth and the other "Lake Poets," Coleridge and Southey. Within a space of about 30 miles square are the largest lake and the highest mountain in England—Lake Windermere, 10½ miles long, and Sca Fell, 3,210 feet high. The numerous lakes—some with steep rock-bound shores, and others with softened wooded banks—show a charming variety, while the hills and mountains rise in sweeping lines from green meadows and woods.

As we approach the Scottish border, we find a reminder of Britain's early history in the remains of the old Roman wall, stretching from a point on Solway Firth west of Carlisle to what is now the busy city of Newcastle on the Tyne—a distance of 73½ miles. Many miles of this great wall still stand, shorn it is true of more than half its original 20 feet of height, but still a carriage-road in width and striding majestically over hill and down dale as in the proud old Roman days.

The Cathedrals of England

Less than 20 miles south of Newcastle on the eastern side of the island is the old episcopal city of Durham. Here stands the hoary cathedral, "half church of God, half castle 'gainst the Scot," which today is the finest existing example of a Norman Romanesque church.

As we travel southward now, we come upon many more of these picturesque old cathedral cities, each with its own individual character. York, the seat of England's other archbishop, has the largest and perhaps the grandest of all English Gothic cathedrals. Hull, on the Humber River, owes its importance to its naval arsenal, fisheries, and commerce; but Lincoln, some 50 miles farther south, presents a cathedral which historically is even more interesting than that of York. Almost four centuries have been built into the great structure, beginning with early Norman days and reaching down into the late Gothic period. The Lichfield Cathedral, in the very heart of England, where once spread the Saxon kingdom of Mercia, is one of the smallest, but also one of the loveliest of these old churches that delight the heart of every New World visitor; and Ely, with its massive Norman towers, rising in the great fen district of Cambridgeshire—now drained and cultivated—is one of the most majestic and impressive of these shrines.

Not far from Ely is the university town of Cambridge, with its historic old halls; it ranks in fame and educational importance with its sister university, Oxford, on the upper Thames, 100 miles to the southwest (*see* Oxford).

Seventy-five miles from Cambridge we come at last to roaring bewildering London—the mightiest metropolis in all the world, the capital of the whole British Empire, and a place where the traveler will wish to spend weeks and months in historical and literary pilgrimages (*see* London).

The Black Country which we saw in the north is a new England created less than 150 years ago by the Industrial Revolution, and it is the home of manufacturing, democracy, and religious dissent. In the pleasant Thames valley and the region south of it we find ourselves at last in the England of agriculture—the land of the Tory squire and the secure domain of conservatism and the church of England. Here is the traditional England of green meadows and hedgerow-bordered fields, where villages of quaint thatched cottages are lorded over by stately manor houses.

The Historic South and Its Hedgerows

Let us now sail down the broad estuary of the Thames, with its myriad ships coming and going on the world's commerce, and turn southward about Kent to skirt the beautiful and historic shores of the southern coast. In Kent the conquering English first landed nearly 15 centuries ago, and there St. Augustine set up his see of Canterbury, the mother church of England. In Sussex, once the kingdom of the South Saxons, William and his Normans set foot on their great invasion six centuries later. Then comes Hampshire, with the Isle of Wight lying off its harbor of Southampton Water, and with the great naval station of Portsmouth at its mouth. What scenes of Britain's naval glory have these waters witnessed, from the time when Drake and his fellows swept up the channel in the wake of Spain's slow-moving Armada, to the review of Britain's mighty fleet on the eve of the World War!

In picturesque Devonshire we come to old Plymouth, name-city for the Pilgrim Plymouth of New World history. Then comes Cornwall and Land's End. And up the west coast a bit we reach the broad Bristol Channel, leading to busy Cardiff, the shipping point for the coal from the rich South Wales field, and Bristol, once the chief port of western England. Sixty miles away, on a little tributary to the Severn River, lies Shakespeare's Stratford; and in less than a day's walk from there we come to Warwick with its showy castle, and Kenilworth, once the scene of splendid revels in mighty Elizabeth's honor.

Everywhere, indeed, in this "tight little island" we come upon traces of historic greatness, vistas of scenic

LINCOLN AND ITS GREAT CATHEDRAL

A ride of 130 miles north from London brings you to Lincoln on the north bank of the river Witham, whose history, like that of Chester, goes back to Roman days. Rising from the crown of the hill on which it stands, you see from afar the glory of the town and one of the chief glories of English architecture—the cathedral or "Minster" of Lincoln.

loveliness, evidences of far-flung empire. To an American traveler the fact is never absent that he is in an old country. He feels that he is in a land of traditions as well as of historic monuments—in a land where things are done in a certain way because of long established custom. But equally he feels that, beneath the superficial fixity of English social and political life, there is a sturdy vitality and common sense and a fluidity of institutions that permit of far-reaching changes by the orderly processes of public discussion and parliamentary legislation, which in other lands could come only by bloody revolution. Truly England is a land where "Freedom slowly broadens down from precedent to precedent"; but at need the progress can become amazingly rapid. Today England is a limited monarchy; but in it political democracy exists to an extent unsurpassed anywhere in the world, and should the people ever demand another form of government they could easily obtain it by peaceful means. (*See* Cabinet; Parliament.)

ENGLISH LANGUAGE. There is an old saying in Europe that Italian is the language to use when you want to sing, French when you want to make love, and English when you want to do business. This is only a popular saying, of course, and not more than half true, but it does show that different languages have different characters just as different people have, and that each one has a different taste to the mind.

It is true enough that English is a good language in which to do business, for probably—taking into account Great Britain, her colonies, and the United States—the greater part of the world's commerce is conducted in English. But English is good for many other uses besides business. Indeed it is one of the richest languages spoken today, with more variety and flexibility than almost any other, and it is spread over a greater part of the earth's surface. English is made up, like the people that developed it, of many national inheritances and foreign importations, and its history and growth make a very interesting study.

Have you ever dug a hole beside a stream and seen the different layers you find as you dig, sand and gravel and small stones one above the other? If you study down into the English language you will find that it was formed in much the same way.

Of course in speaking we do not notice these layers at all. The words are all mixed together, so that often in a single sentence you will say words that come from all the different layers. If you say for instance, "My mother received a good telegram," you have used words from four different sources. "Mother" is a very old word and comes from the original Indo-European root language; "received" is a word of Latin origin; "good" is a Teutonic or Anglo-Saxon word; and "telegram" is from the Greek.

English is classified by philologists or scientists who study words as a Teutonic or Germanic language. This is not because more of our words are Teutonic—as a matter of fact not more than one-fourth of the words in the dictionary are Teutonic—but because the Teutonic words are the framework of the language, the connecting words and the simple fundamental names of ordinary things. So that in spite of the fact that only one-fourth of our words are Teutonic in the dictionary, in ordinary speech about four-fifths of the words we use are Teutonic. Another reason is that we put our words together with the grammatical construction of the Teutonic languages.

After the Teutonic words the most important are the words of Latin origin which have come to us either from the Latin direct, or through the French or Italian or Spanish, but especially French. These words have a different feeling from the Teutonic words when you know them. They are more polished, more stylish you might say, more precise. At one time the Normans, who spoke French, came over and conquered England and ruled over the Teutonic people, the Anglo-Saxons, who lived there. So it came about that the words the common people used stayed Anglo-Saxon or Teutonic and the words of the wealthy and ruling classes became Latin. For instance as long as a sheep was alive and was tended by the shepherds, who were common people, it was called by the Teutonic word "sheep," but as soon as it was cooked and came on the table of the noble classes, it became "mutton," a French word. In the same way "cow" is Anglo-Saxon and "beef" is French; "hog" is Anglo-Saxon and "pork" is from the language of the conquerors. The influence of the church, the classical Renaissance of the 16th century, and the later coining of scientific terms from the Latin, greatly increased this element in English.

One great advantage which English has over many other languages is the ease with which it forms new words out of old by simply joining them together, as in "rainfall," "railway," "backslide," outcome," "daisy" (from "day's eye"). It is also rich in prefixes and suffixes which can be added to existing words to modify their meaning. Thus we form nouns by the use of such suffixes as *-ness*, *-dom*, *-age*, *-tion*, *-ment*, *-or*, *-ess*, giving us such words as "wickedness," "kingdom," "porterage," "accusation," "amazement," "actor," "prioress." The suffixes *-al*, *-ic*, *-ous*, *-able*, *-ful*, *-ly*, etc., are used to form adjectives, as "critical," "pedantic," "famous," "approachable," "tuneful," "lovely." The prefixes *anti-*, *pro-*, *re-*, *inter-*, *un-*, and a host of others enable us to make such useful words as "anti-slavery," "pro-Boer," "reclassify," "interurban," "unnecessary."

The Force in Our Mother Tongue

In general the words of Latin origin are not as strong or as full of meaning as the Teutonic words. For instance the Anglo-Saxon "friendship" has its Latin equivalent "amity," which means just the same thing, but it is a pale word and not nearly so good for most purposes. In poetry, where the color of words is very important, Anglo-Saxon words are usually better than Latin words. But the Latin words have the advantage of being more exact and scientific and for certain purposes are better.

The Greek words are much fewer in number and are largely scientific words, like "geology." We have a number of Dutch words, particularly about the sea, like "schooner"; Scandinavian words (mostly from the old Danish conquest), like "earl," "take," "window"; a few Indian words, like "tomahawk"; some Hebrew words, like "hallelujah"; a good many from the Arabic, like "alcohol"; and an assortment of odd words from almost every other language. We have, too, a few words made up out of whole cloth to describe new things, like "gas" and "kodak," and others, like "buzz," "splash," "chick," are imitations of the sound of things. Some words, too, are names of people, like "sandwich," which came from the Earl of Sandwich, who was too busy gambling to eat regular meals and invented the quick lunch we call by his name; and "boycott," named after an Irish land agent who was its first victim.

Anglo-Saxon the Basis of English

The language of the old Britons was Celtic and survives in modern Welsh, which is still the tongue of Wales. When the Romans conquered England they introduced a certain number of Latin words in the three centuries that they ruled the island. But when the Anglo-Saxons came over from the north of Europe they brought their own Teutonic language with them, which is the basis of English, and there was very little admixture of Celtic and Latin from the conquered inhabitants. The earliest written examples of this Anglo-Saxon are from the 7th century.

The periods in the development of the English language are called Old English (or Anglo-Saxon), Middle English, and modern English. Old English was spoken from about 449 A.D. to 1100, and was very highly inflected—that is, it had a complicated system of grammatical changes to indicate case, number, person, tense, and the like. Middle English was spoken from about 1100 to about 1500, and was much less highly inflected; and modern English, which has developed since 1500, has lost its inflections almost entirely. English speech supplanted French in Parliment and in the law courts of England in 1362.

There have always been, and are today in fact, though now they are only dialects, three varieties of English spoken in England—Northern, Southern, and Midland English. Northern English was important in the very early days and later developed into the Scotch dialect, such as you find in Robert Burns's poems. Southern English was the most important in the Old English period, especially under King Alfred. Modern English developed out of Midland English, in the Middle English period, which stood about halfway between the two. The poet Chaucer, who wrote in Midland English, and the King James Version of the Bible and the English Book of Common Prayer did much to set modern English in the form it now has. Since about 1500 the written language in most important respects has been much as it is today. But the spoken language often differs considerably from the literary tongue, and every age and region has its own dialect, or slang expressions (*see* Slang).

How many words are there in the English language? In the ordinary unabridged dictionary you will find from 300,000 to 500,000, but of course no one person ever uses all of these. It has been calculated that Shakespeare, who had a very wide vocabulary, used not more than 24,000 words in his writings, and 5,000 of those he used only once. Milton uses 17,000 words, and the English Bible only 7,200. In ordinary life few persons use more than 2,000 or 3,000 words. The Greek poet Homer paints all his marvelous pictures of battle and adventure by land and sea with about 9,000 words. (*See also* Philology.)

The Glorious Pageant of ENGLISH LITERATURE

WHAT a wonderful heritage is left to the world in the works of the great writers of England! A strong free people of high ideals, with a faculty for absorbing the best from the races they have touched, the English have embodied these traits in their literature, making it one of the great literatures of the world. Here the absorbing story of the rise and growth of this great body of prose and poetry—from the early Anglo-Saxon hero-tales to the floods of fiction, poetry, drama, and essays that today pour from the printing presses of Great Britain—can only be sketched in briefest outline. But in the separate articles scattered throughout this work, on the lives and works of the important writers, you will find the means of filling in with life and warmth this bare skeleton.

ENGLISH LITERATURE. The dawn of English literature began back in the times when the Angles and Saxons still lived in Jutland and along the North Sea shores, and spoke a Teutonic language that no one can read now without studying it as he does a foreign tongue. In the middle of the 5th century these peoples—the Anglo-Saxons—came to Britain, conquered the Celtic inhabitants, and drove them westward. They brought with them a mass of tales in verse, sung by wandering minstrels in camp and hall. 'Beowulf', one of these anonymous tales, was finally written down by some unknown singer, and thus becomes the first landmark in English literature. The first poet whose name has come down to us was Caedmon, who made a metrical translation of parts of the Scriptures about the year 670. The greatest prose writer in Anglo-Saxon was good King Alfred, who translated Latin textbooks for his people and started the 'Anglo-Saxon Chronicle'.

The Normans, who conquered England in 1066, brought with them the French language. But being of the same original stock as the English they gradually united with them, and the language of the country became English modified and enriched by French. Wyclif's translation of the Bible (1380), the most important prose work of the 14th century, set a standard of English prose and made it the people's language of religious thought. During those years while the language was forming, the old Welsh legends of King Arthur became popular, chiefly through the Latin writings of Geoffrey of Monmouth, a Welsh monk, the date of whose death was probably 1154.

England's First Great Poet

Geoffrey Chaucer (1340?–1400) is England's earliest great poet. He belongs to the springtime of English poetry. His 'Canterbury Tales' give us colorful pictures of people who lived in England then—knight, innkeeper, nun, merchant, and many others—all journeying on a pilgrimage in April, telling stories to pass the time, while—

> . . . smale fowles maken melodye
> That slepen all the night with open ye (eye),

and the fresh and charming English countryside blossoms around them in all its beauty.

The years of the 15th century, after Chaucer, though they showed in England no important writings, were a busy time of preparation. All Europe was awakening to the renewal of classical learning; for the Greek and Roman literatures, lost to western Europe for nearly a thousand years, were now brought to light. The invention of printing, brought to England by William Caxton, made it possible to spread books and knowledge abroad. The world was growing larger, too, for that century saw the beginnings of the age of discovery. Fearless men were seeking truth in religion, and the Reformation was being prepared. (*See* Reformation, Protestant; Renaissance.)

CHAUCER
England's First Great Poet

In England the New Learning was represented by the famous Dutch scholar Erasmus (who came to England in 1497), by John Colet, the learned and lovable dean of St. Paul's, and by Sir Thomas More, England's wittiest Lord Chancellor. More's 'Utopia', though written in Latin, reflects English thought about society and religion. The Reformation worked great good to the English language, for William Tyndale's translation of the Bible helped to fix the standard of English speech and literary style.

There was little new poetry in that time, but Caxton's printing press spread broadcast the work of Chaucer and other native poets of merit. Caxton printed, too, Sir Thomas Malory's 'Morte d'Arthur', an English prose translation of Arthurian legends compiled from French sources. In the lowlands of Scotland some poetry was written, the best by William Dunbar; and this Scottish strain, with its warmth of feeling and love of nature, was a powerful influence on the writers of a later day.

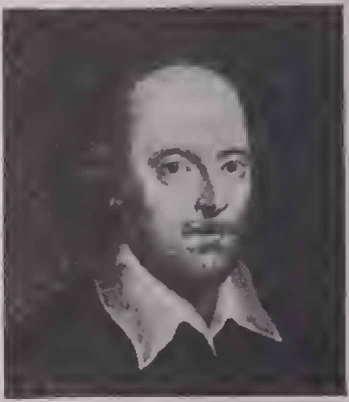
The Glorious Age of Elizabeth

All these new influences—renaissance of learning, religious reformation, travel, discovery, invention—worked rather slowly on English literature. But in Elizabeth's time (1558–1603) they flowered out in the most wonderful creative period in the history of English writing. Poems, ballads, masques, and pageants, the ancient classics and new romances and verse forms brought home by travelers in Italy, stories of voyages, books of religious reform, the Bible in English—all supplied inspiration, and England became a land of poets.

SPENSER
Author of 'Faerie Queene'

Edmund Spenser's 'Faerie Queene' finely embodies the wonder, freshness, and beauty of the age, with nothing ugly or coarse. It is a long story-poem of the adventures of the Red Cross Knight and other knights who personify the virtues fighting against evil. Spenser's work is pure and true, and rich in passages of delicate beauty.

For centuries the drama had been growing up gradually, through the "mystery," "miracle," and "morality" plays, presented to teach the people Bible stories, the life of Christ, and the moral virtues. The real English drama began to appear in the later 16th century, with a group of powerful playwrights, of whom our unrivaled Shakespeare was by far the greatest, not only of the period, but of all time to date.



SHAKESPEARE
The World's Greatest Dramatist

Shakespeare "touched life at all points," and something of all he saw and felt went into his plays. King and queen and peasant, wise man and fool, of his own time and of the past, walk before us. We sound the depths of human tragedy in 'Hamlet' and 'Lear'; revel in fairy legend in 'Midsummer Night's Dream'; laugh uproariously with Falstaff in 'The Merry Wives of Windsor'; and wonder at the peaceful beauty of 'The Tempest'. Shakespeare touches every emotion and speaks to all times and nations. Through him England reached its supreme poetic expression.

After Shakespeare's death drama and poetry gradually declined. "Rare Ben Jonson" wrote carefully wrought plays and lovely songs; Beaumont and Fletcher were dramatists with flashes of extreme vigor and beauty; but none had the gift of supreme genius.

Age of Puritan and Cavalier

The times of James I and Charles I, in which the Elizabethan impulse largely persisted despite the rising tide of Puritanism, produced many beautiful lyrics, such as those of Herrick, Lovelace, and Suckling. George Herbert and George Wither found inspiration in religion. The most important prose writer of the time, the one who still speaks to us as forcefully as to his own time, was Francis Bacon, whose profoundly penetrating 'Essays' will "live as long as books last," as he himself foretold. Bacon also originated the method of the new scientific research based on experiment which has led to the wonderful progress of modern science.

FRANCIS BACON
Essayist and Philosopher

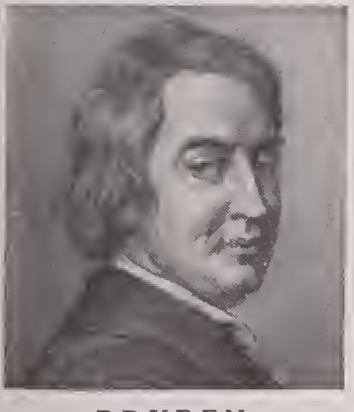
The Puritan standards in religion, morals, and government which had been gaining power, at last prevailed in the civil war between crown and Parliament. In the main the Puritan age which followed was more favorable to the development of prose than of poetry, for philosophy, religion, and government were constant subjects of thought and controversy. Yet, though the age was one of argument and contention, it produced Milton, who stands next to Shakespeare in the galaxy of English poets. In his beautiful early poems, like 'Il Penseroso' and 'L'Allegro', Milton's genius is more akin to the spirit of the Elizabethan age than that of his own time. In his 'Areopagitica' (on the freedom of the press) and other prose writings, he serves the cause of liberty. In his sublime 'Paradise Lost' he expresses the Puritan spirit at its loftiest and best. It is England's great epic poem, written in the noblest of blank verse.

MILTON
The Noble Puritan Poet

Another great Puritan, who stands with Milton as a representative of the age, was John Bunyan, the non-conformist preacher who wrote 'Pilgrim's Progress'. This story of Christian's journey from the City of Destruction to the heavenly country is an allegory full of meaning and charm for children and simple people as well as for wiser folk. It has been translated into more languages than any book save the Bible. Three quaint books of the time, sometimes read now for their wisdom and pleasant fancy, are Robert Burton's 'Anatomy of Melancholy', Sir Thomas Browne's 'Religio Medici', and Izaak Walton's 'Compleat Angler', sometimes called "The Bible of Fishermen."

The Restoration and Queen Anne

With the return of the Stuarts in 1660, and the removal of Puritan restraints, some forms of literature showed a natural reaction. The drama especially reflected the immorality and frivolity of the court life. The more serious poetry and prose underwent great changes. Writers felt less and had less to say; so they gave less attention to *what* they said than *how* they said it, emphasizing especially simplicity and directness of style. Their subjects were mainly social and political.



DRYDEN
Great Poet of the Restoration

John Dryden, "the greatest man in a little age," led in the new poetry. His 'Absalom and Achitophel' is the greatest political satire in the language. Dryden also wrote plays, but his great influence has been through his masterly critical essays, which were one of the most weighty factors in the formation of modern English prose style. Samuel Butler's 'Hudibras' was a fiercely satiric poem against Puritanism. In their gossipy diaries, Evelyn and Samuel Pepys give "the very taste and color of life" in their times. There were also far-reaching developments in science, and the Royal Society was founded in 1662. Sir Isaac Newton's 'Principia' began a new age in science, while John Locke's 'Essay Concerning the Human Understanding' opened new fields in philosophy, as his 'Essays on Government' did in political thought.

In the early 18th century, under stupid but good Queen Anne, standards of personal and political morality were low, and there was little left of the old Puritan loftiness of purpose. As in the preceding age, writers were weak in feeling and imagination, and turned largely to satire and criticism. But they laid increasing emphasis on perfection in literary form—clearness, smoothness, and regularity—developing a beautifully elegant and polished prose style. Because of this, the period is one of the great ages in the history of English literature.

Alexander Pope was the preëminent poet, brilliant in satire and criticism. In his 'Essay on Criticism', his 'Rape of the Lock', and his verse translation of Homer, he used the rhymed couplet, then considered the perfect verse, for irregularity and lack of smoothness were counted barbaric faults. Such regularity seems monotonous now, but we still quote Pope for his concise and perfectly rounded sayings.

POPE
Brilliant Satirical Poet

But the reign of Anne was preëminently an age of prose. The most original writer of the day and one of the most powerful satirists of all time was Jonathan Swift, author of 'Gulliver's Travels', which bitterly and mercilessly holds man's faults and weaknesses up to scorn. The periodical essay as developed by Addison and Steele was a new order of writing, which held the germs of three of the most important factors in modern life — the novel, the magazine, and the newspaper. These two men wrote for *The Tatler* and *The Spectator* essays on English life, morals, and manners, ridiculing gently the failings of the age and bringing a tone of culture and good breeding into clubs, coffee-houses, and homes. Sir Roger de Coverley, the English country gentleman, immortalized in a group of the *Spectator* papers, is a well-loved book-character. Addison's kindly humor and smooth elegance make his essays delightful reading.

The kindly human tone of Addison's work is one evidence of changes working in morals and literature.

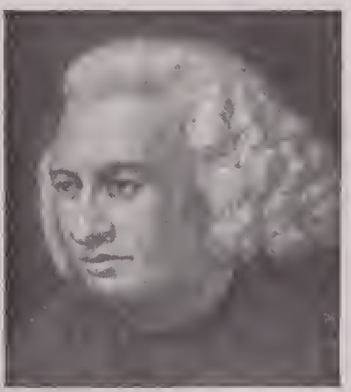
There was warmer feeling in religion and great emotional preachers like Whitefield and the Wesleys soon were reaching the lower classes. Interest in romance and nature reappeared, in the period 1740–80, in Macpherson's professed translation of the epics of the Gaelic Ossian, and in Bishop Percy's collection of old ballads, the 'Reliques of Ancient English Poetry'. Love of nature animated the poems of William Collins, James Thomson, and Thomas Gray, author of the 'Elegy in a Country Churchyard'. Oliver Goldsmith's 'Deserted Village' has both beauty and feeling, and his play 'She Stoops to Conquer' is full of hearty fun.

BURNS
"The Scottish Song-Bird"

The character studies of Addison and Steele, the stories of Swift and Daniel Defoe, author of 'Robinson Crusoe', and the revived interest in old-time romance pointed the way to the new form which today provides the greatest part of our literary pleasures—the novel. 'Pamela' by Samuel Richardson heads the list. Henry Fielding, Oliver Goldsmith, Laurence Sterne, and Tobias Smollett all added valuable elements to the new literary type and their novels served as models for those that followed. Goldsmith's charming 'Vicar of Wakefield' (1776) remains a favorite.

SCOTT
Creator of the Historical Novel

But above the literary life of the times towers the huge bulk of Dr. Samuel Johnson, great conversationalist and arbiter of literature. Johnson wrote a 'Dictionary', a series of 'Lives of the Poets', 'Rasselas', and many periodical essays; but his personal influence was far more potent. He, with the artist Reynolds, founded a famous literary club, of which the statesman Burke, Goldsmith, the biographer Boswell, the historian Gibbon, and the great actor Garrick were members. Johnson's own style was ponderous and full of large resounding words. His emphasis on classical severity and dignity held back somewhat the advance of the freer spirit of romanticism with its bold originality and rejection of ancient precedents. Happily (since the man himself is more interesting than his works) we have a remarkable biography of him by his friend and worshiper, James Boswell.


SAMUEL JOHNSON
Huge in Figure and Learning

The old standards could not hold long in a time when men were thinking of freedom, when governments were changing, and the people were making themselves heard. Love of liberty animated all who thought deeply. Literature revolted from its old limitations and found free expression for thought and feeling.

William Blake and William Cowper were forerunners of a new outburst of poetry and prose. From Scotland, whose poets had long loved nature and freedom, came Robert Burns, singing the new brotherhood and democracy—

> A man's a man for a' that!

and the love of nature, the tender sentiment and the rollicking humor of his race, in poems like 'To a Mouse', 'The Cotter's Saturday Night', and 'Tam o' Shanter'. Another poet of Scotland was Sir Walter Scott, who put stirring border tales into poems like 'The Lady of the Lake'.

Greatest of all the nature poets was William Wordsworth, who better than anyone else leads one to understand meanings hidden beneath nature's outward forms. To this modern day he speaks most effectively in his beautiful meditative short poems, and in sonnets like—

> The world is too much with us, late and soon—

Samuel Taylor Coleridge wrote only a few truly great poems, but those few are unexceled for imagination, penetrating vision, and melody. 'The Ancient Mariner' stands alone in magical rendering of the supernatural and fantastic.

The spirit of revolt that is the outstanding characteristic of the time appears in most intense form in the poetry of Lord Byron, who went his unhappy and tempestuous way, until he died fighting for Greece. 'Childe Harold's Pilgrimage', 'Don Juan', and others of his fiery poems exercised an incalculable influence on the younger writers of his day.

Most ardent of the young poets of liberty was Percy Bysshe Shelley. His longer poems soar into a spiritual region whither not every one will follow him. But we all can enjoy such exquisite lyrics as 'The Cloud' and the 'Ode to the West Wind'. Like his own 'Skylark',—

> Higher still and higher
> From the earth thou
> springest
> Like a cloud of fire.

The other poet of this group was John Keats, whose early death Shelley mourns in 'Adonais'. Keats was deeply moved by passionate love of beauty for its own sake. Such short poems as 'On a Grecian Urn' or 'To a Nightingale' have unsurpassed beauty, and such music as—

> . . . . hath
> Charmed magic casements opening on the foam
> Of perilous seas in faery lands forlorn.

WORDSWORTH
The Poet of Nature

At the same time Scott created the historical novel. His marvelous Waverley Novels—'Ivanhoe', 'The Heart of Midlothian', and many others — were the favorites of the age and were read all over Europe. Even today his popularity has not begun to wane. Another novelist was Jane Austen, one of the first to write, in her 'Pride and Prejudice' and other novels, interesting stories of commonplace people.

BYRON
Fiery Singer of Revolt

Thomas De Quincey wrote voluminous essays in a beautiful and elaborate style. Most lovable of essayists is Charles Lamb, author of the gentle, whimsical 'Essays of Elia'. He and his sister Mary retold for children 'Tales from Shakespeare'.

The Victorian Age and After (from 1837)

By the time Queen Victoria came to the throne, a new age was producing new writers. Astonishing scientific discoveries and inventions had revolutionized life. The idea of evolution changed wholly the outlook of science and philosophy and affected religious thought (*see* Evolution). The spread of democracy, of popular education, of social unrest, was reflected in the poetry and prose of the time.

BROWNING
Master of Subtle Meaning

The two chief poets were Alfred Tennyson and Robert Browning. Tennyson wove the King Arthur stories into the 'Idylls of the King', which together make a long poem rich in meaning and imagery, melodious in language. 'In Memoriam' and 'Locksley Hall' mirror the religious and scientific spirit of the day. Browning wrote stirring narrative poems, searching character analyses, dramas, and love poems. He is always confident of the triumph of good.

> There shall never be one lost good! What
>   was shall live as before;
> The evil is null, is naught, is silence implying sound;
> What was good shall be good, with, for evil,
>   so much good more;
> On the earth the broken arcs; in the heaven
>   a perfect round.

His wife, Elizabeth Barrett Browning, wrote the love poems, 'Sonnets from the Portuguese'. Other famous poets were Matthew Arnold, Dante Gabriel Rossetti, and Algernon Charles Swinburne.

DICKENS
Novelist of English Common Life

Matchless among prose authors for clear, forcible, picturesque studies of great men was Macaulay. Thomas Carlyle spoke directly, flamingly, to arouse people to thinking, in his 'Sartor Resartus' and 'Heroes and Hero Worship'. John Ruskin, Matthew Arnold, and Walter Pater compose a group of critical writers of the first rank.

TENNYSON
Victorian Poet Laureate

Prose fiction was now the chief art form and innumerable novels were written. Charles Dickens, author of 'Pickwick Papers' and 'David Copperfield', with his humor, pathos, and understanding of human nature, is one of the best-loved authors. William Makepeace Thackeray, the keen but kindly satirist of English life in 'Vanity Fair' and 'The Newcomes', is scarcely less a favorite. 'Middlemarch', 'Silas Marner', and the other novels of George Eliot, England's greatest woman novelist, all have their problems and serious purpose. The two dominant figures in the novel of the later decades of the century were George Meredith ('The Egoist') and Thomas Hardy ('Tess of the D'Urbervilles'). Old and young love the vigor and youthful spirit of adventure in Robert Louis Stevenson's 'Treasure Island' and 'David Balfour', and the delicate charm of his essays and verse. Rudyard Kipling, with his stories of the 'Soldiers Three', his ringing poems, and such children's tales as 'The Jungle Book', is another favorite.

Recent years have further accentuated the tendency to make the novel a vehicle for discussion of social problems. Some of the distinguished novelists of the time are John Galsworthy, at his best in 'The Patrician'; H. G. Wells, whose most famous novel is perhaps the war story 'Mr. Britling Sees It Through'; Arnold Bennett of the Five Towns novels; and George Moore, author of 'Evelyn Innes'. Joseph Conrad's stirring tales of the sea are among the greatest of modern novels.

The drama, influenced largely by the same social impulse seen in the novel, has experienced a revival that lifts it higher than it has been since Shakespeare's time.

Conspicuous among recent poets are Stephen Phillips, writer of beautiful poetic dramas, William Ernest Henley, Laurence Housman, Francis Thompson, Kipling, Alfred Noyes, William Butler Yeats, and the poet laureate, Robert Bridges. A new and deeper note has been struck in the plays and poems of John Masefield and Wilfrid Wilson Gibson. Free in style and thought, they have found in mill and factory, in moorland shepherd homes, and on ships at sea their tragedies and poems of humble life. Another notable group is that of the young poets of the war—Rupert Brooke, who was killed, and Robert Nichols, Robert Graves, and Siegfried Sassoon.

Whether any of the voices of today are truly great, the future must tell. But there is assuredly in their work a powerful desire for freedom, the sense of brotherhood, the joy in life and beauty and adventure, and the broad prophetic vision for the future that make for great literature. (*See also* Drama; Essay; Novel; Poetry.)

PICTURES *for* ALL *Through the* ENGRAVER'S ART

PICTURES are the most universal language. They convey ideas to men of different tongues, to the little child as well as to the adult, and often they do this more vividly than many paragraphs of description. Next to the art of printing, pictures are the great educators of the world. And the possibility of distributing pictures everywhere, through our books and magazines and newspapers, we owe to the art of engraving. Here is told the story of the engraver's art, from the early wood-cut and copper-plate prints, to the fine etchings, steel-engravings, lithographs, rotogravures, and photo engravings of today.

ENGRAVING. In the Middle Ages the old monks beautified the parchment of their hand-written books with initials and brilliant pictures, painted in rare blues and gold and crimson. But these were the luxury of the learned rich. Some time before printing from movable types was invented (*see* Printing) men learned to print from crude woodcuts—playing cards, and short religious tracts and booklets; and often these also were adorned with pictures. Most people could not read, so the tracts at times consisted almost entirely of pictures, with only a few words of text at the bottom.

At first these pictures were very crude, and many of them are so quaint that today they make us smile. It was not long, however, before the engravings became things of beauty, and not mere diagrams to illustrate a point. Many of these old illustrations are prized possessions now, for museums, libraries, and private persons make collections of them, and large sums are often paid for a single print.

The Three Ways of Printing Pictures

There are three ways in which designs can be printed on paper. First, there is *relief* printing, in which the design to be printed stands up in relief, as type does on a typewriter, in printing, or on a rubber stamp. The second method is from a *lowered* surface, the ink being pulled from lines or depressions cut in a metal plate onto moist paper or cardboard, as in printing copperplate calling cards. The third method is printing from a *flat* surface, without perceptible relief or depressions, as is the case in lithographing. In all of these processes, of course, the lettering or design must be *reversed* in the engraving, as otherwise when printed it would resemble reading matter seen reflected in a looking glass.

Until late in the 19th century, engraving was mostly handwork. Wood engraving was the oldest means by which illustrations were made. In this method the artist first draws the design on a boxwood block, and then carefully cuts away between the lines with a chisel-like "graver," until the whole pattern stands high in relief, so that when it is inked the design can be printed. The Chinese have been stamping pictures on paper and silk with wood blocks for many centuries, and incised blocks of wood have been found in some of the ancient tombs of Thebes. The Assyrians, it is believed, stamped designs on bricks with similar blocks, and the scribes of the early Christian era often used stamps for the ornamental capital letters in their manuscript books. Wood engraving was the method used for illustrations in the first printed books, and it remained in common use until about 1880. Wood engraving had one great advantage over other old forms of engraving, for blocks so engraved could be printed on an ordinary printing press along with the type, while other old engravings had to be printed separately.

"Line engraving" prints from depressions *below* the surface. For a long time it held first rank, in the engraver's art, and was used by great artist-engravers like Albrecht Dürer, Rubens, Van Dyck, and others. In this method, lines and depressions are cut on copper or steel; these are filled with ink and the remainder of the surface of the plate is wiped clean. When the plate is pressed down on a sheet of moistened paper, the ink is transferred to the paper.

How Line Engraving was Discovered by Accident

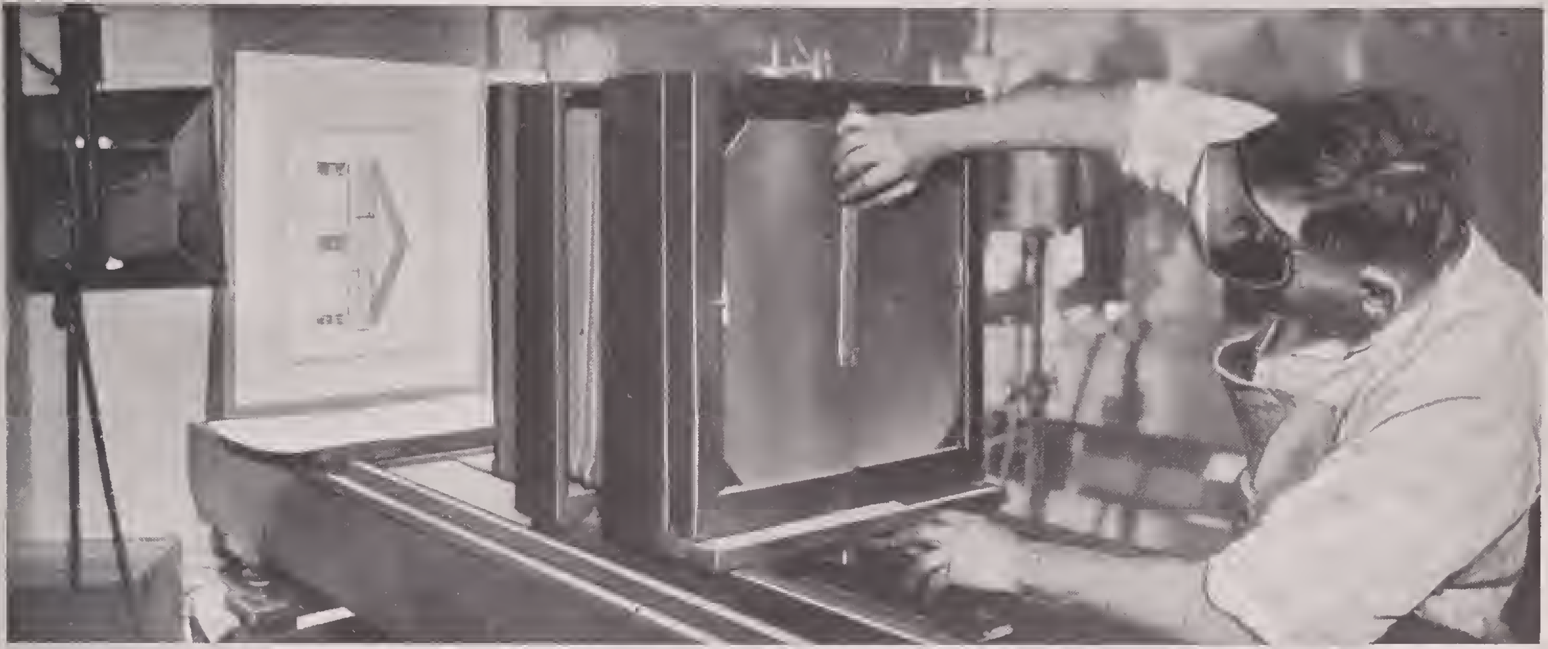
That it is possible to print from such a plate was discovered quite by accident by an Italian goldsmith who was decorating gold- and silver-ware by filling engraved lines with enamel and allowing it to harden. To obtain the effect he desired, it was his custom to rub soot and oil into the incisions before permanently filling them with the enamel. One of these plates was accidentally laid face downward, and when it was taken up there was the design printed on the white surface on which it had rested.

Artists quickly seized on this idea, and for nearly four centuries line engraving ranked as one of the highest arts. Incisions were made on steel or copper plates with a "graver" or "burin," and the various effects of light and shadow, of the folds of draperies, and the flesh tints, were produced by lines cut to different depths and thicknesses. Each printed impression required a separate inking and cleaning of the surface. Today the only commercial use of line engraving is in printing calling cards, invitations, bank notes, and fine maps.

How We Get Our Beautiful Etchings

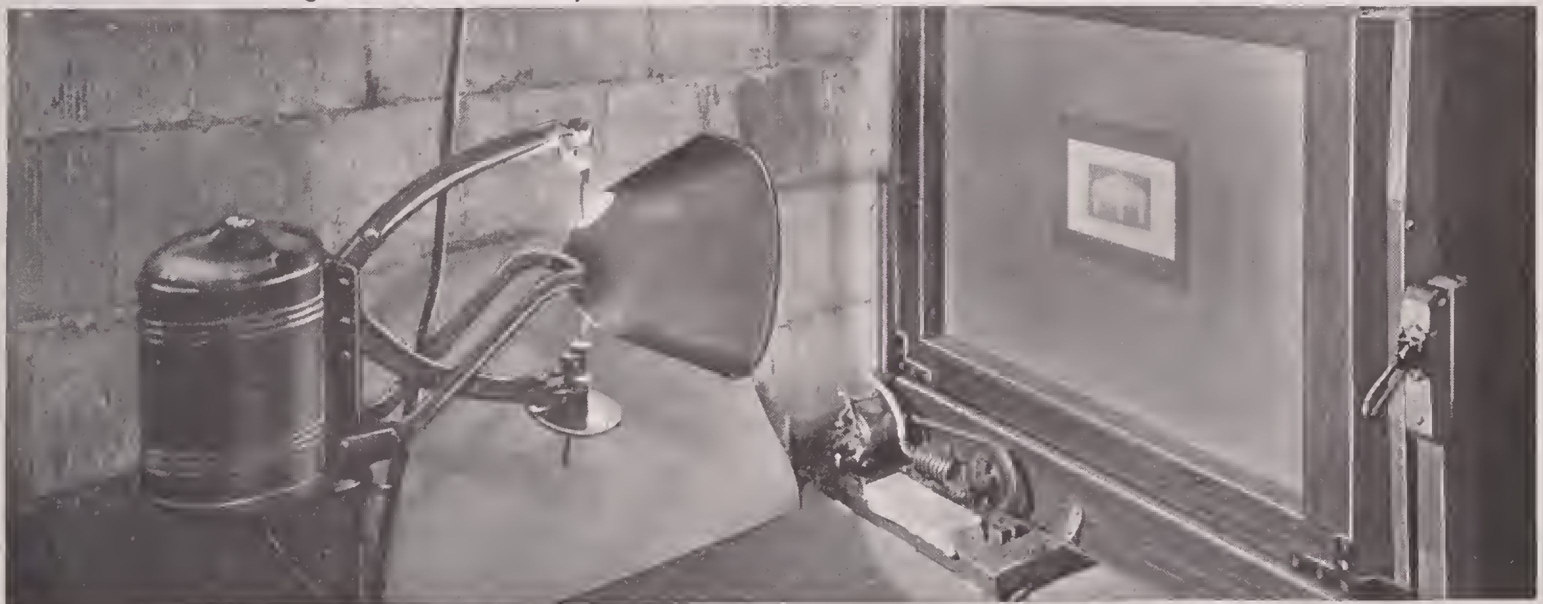
Etching is a development of this process which still has high artistic rank. The entire copper plate is first coated with a mixture of beeswax and other sub-

FIRST STEP IN MAKING AN ILLUSTRATION FOR THIS BOOK



If you will turn to the article on "Architecture," you will find reproduced the very picture you see here. The cut was made as here shown. The artist's drawing was placed upon the easel and photographed to exactly the right size through a "screen" of closely ruled lines running at right angles to each other on a big piece of glass. That made a photograph composed of exceedingly small dots, distributed in such a way that they made light and dark places corresponding to the dark and light shades of the drawing.

Next we see the photographic negative after it has been "developed," to bring out the picture. Notice that the lights and shades of the original are now reversed, so that the background appears dark and the picture itself light.



Here is the copper plate with the negative in front of it. The copper has been coated with a solution that is sensitive to light. As the powerful rays of the arc-lamp strike it, this coating is changed in such a way that the half-tone dots of the negative will register on the copper. When the copper is later immersed in acid, these "dots" will be protected and the spaces between eaten away.

stances which have been heated until they are liquid. After this has hardened, the design is drawn on the wax with an etching needle, scratching lightly through to the copper. A powerful acid is then poured on, which eats into the copper wherever the metal has been exposed, without affecting those portions protected by the varnish. After the lines have been eaten out to the proper depth, the plate is cleaned, and it is ready to be printed in the same manner as the line engravings. The line engraver gives more accurate details, but the etcher has more freedom of line and shading. Etching was invented early in the 16th century. Among the great artists who early used this process are Dürer and Rembrandt. The greatest of modern artist-etchers are the Englishmen J. M. W. Turner, F. S. Haden, and Frank Brangwyn, and the Americans J. A. McNeill Whistler and Joseph Pennell.

The "mezzotint" process, which is a modification of etching and line engraving, was carried to great perfection a little more than a century ago. Here the plate is first roughened all over with a tool called a "rocker" until it resembles nothing so much as a piece of plush; if it were now inked and printed, the result would be a mass of deepest black. After the outline of the design has been traced, the artist scrapes away more or less of the roughened surface, as the parts require to be light or dark. Those portions scraped the deepest take the least ink, while the parts least affected produce the deepest shadows. This method was used very extensively for portraits.

In "stipple engraving," dots and holes etched into the plate make up the design. This style was often used in combination with the other processes for reproduction of flesh tints. "Steel engravings" are usually produced by etching, but the graver is also used. The chief advantage was in the larger number of prints that could be made from the harder metal.

Surface printing began in the latter part of the 18th century when "lithography" was invented. In this process the design is drawn in greasy ink on polished slabs of limestone of fine texture, and the surface is then wetted. The water remains only on the parts not protected by the greasy ink. If a roller covered with printing ink is then passed over the stone, the ink sticks to the greased portions, while the parts wet with water repel the ink and remain clean. All that is needed is to press a piece of damp paper down on the stone, and it will receive an impression in ink of the design drawn on it. Various methods are used for transferring designs to the stone, such as drawing with a pen or brush, transferring designs printed or drawn on specially treated paper, or photographing.

Lithography was invented by a German named Senefelder in 1796. As an art it reached its height in France during the reign of Louis Philippe (1830–1848). Many painter-lithographers used it as a means of artistic expression, finding it permitted far greater freedom than steel, copper, or wood engraving, because it made possible an infinite variety of tones. It is still used for artistic show-bills, labels, etc.

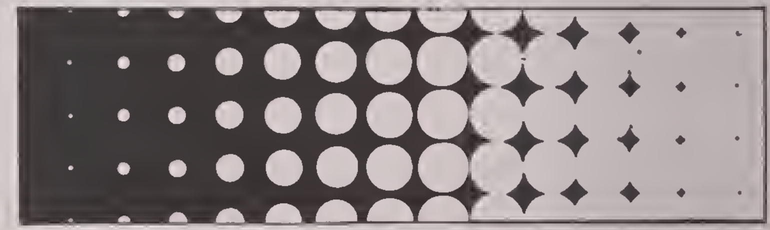
About the time that lithography was at its height, however, photography was invented, and a new day for engraving dawned. The wonderful effects that can be produced by the photo-mechanical processes are possible because some substances, such as gelatin, albumen, asphaltum, etc., undergo changes when exposed to light and heat (*see* Photography). The illustrations now used most commonly in our books and magazines are made by the "half-tone process."

In a photograph the light passing through a negative produces various shades on the sensitized paper, ranging from the lightest grays or browns to the densest blacks. But in ordinary printing only one kind of ink, usually jet black, can be used at a time. This difficulty was solved by photographing the design onto the printing plate through a glass "screen," ruled criss-cross with fine diamond-cut lines, often as many as 150 or 200 to an inch. These have the effect of "breaking up" the design into a multitude of fine dots of varying sizes, with white spaces of greater or less extent between. If you look at a photo-engraving, especially through a magnifying glass, you can readily see this "half-tone" appearance, which makes possible the representation of all tones and shades by one printing of black ink on white paper.

How Half-Tone Cuts are Made

In making a half-tone "cut," or engraved printing block, the design is first photographed through the "screen," and the "negative" thus obtained is then placed in contact with a sheet of polished copper coated with a preparation of fish glue, bichromate of ammonia, albumen, and water. Where the light strikes through the negative, this coating is hardened, but elsewhere it remains soluble in water and can easily be washed off. An acid or other chemical bath then etches into the exposed parts of the plate, leaving only those parts of the surface which are to appear in the printed engraving. After mounting the plate on a wooden block to make it "type high," the cut is printed the same as a woodcut.

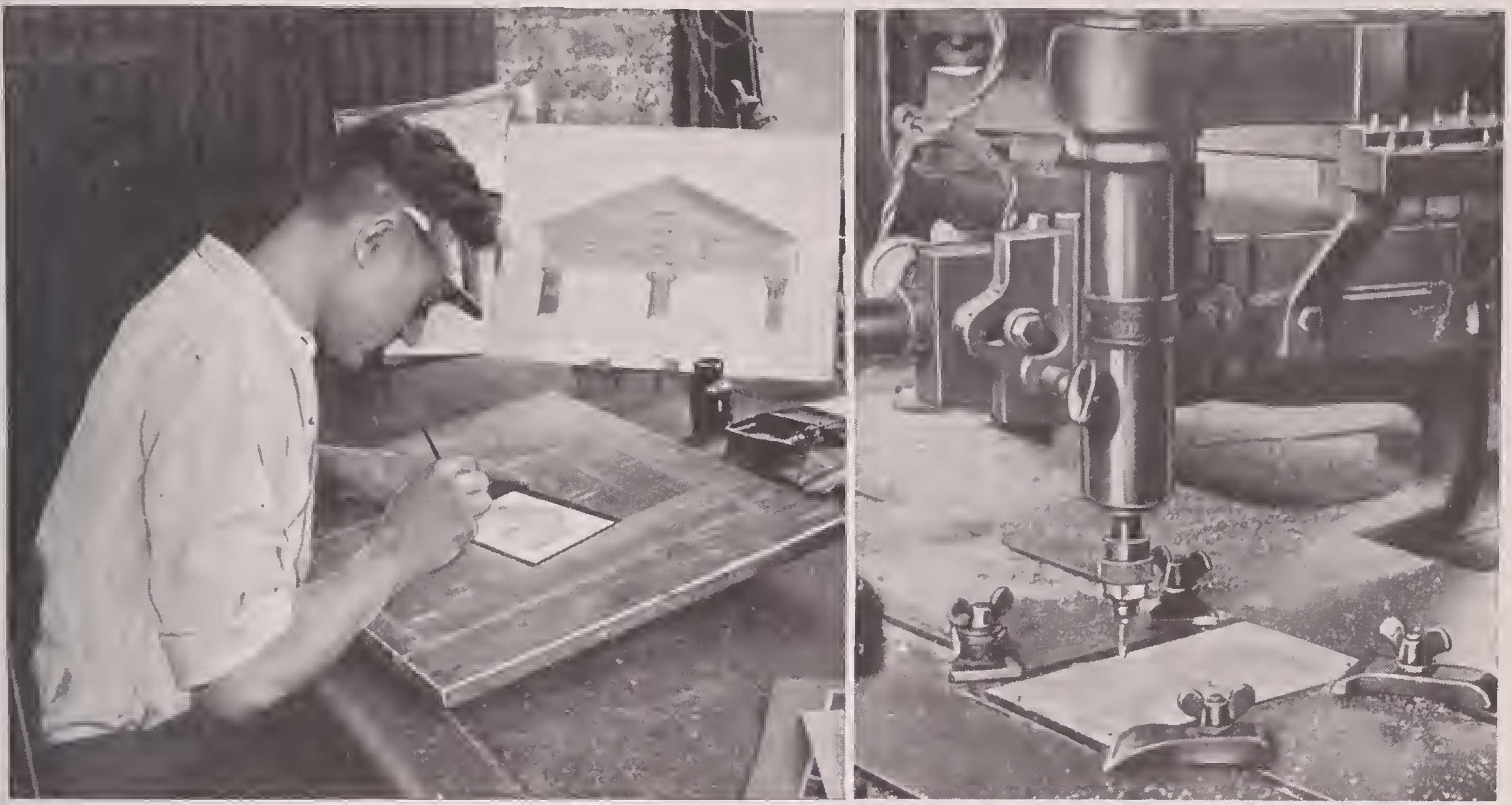
THE SECRET OF THE "HALF-TONE"



Here is part of a "half-tone" cut enlarged more than 40 times. The black portions are the raised parts of the copper which will receive the ink and transfer it to the printed page. The white portions are the "etched" hollows or valleys between, which will leave the page white. By this variation of density all shades from almost solid black to almost pure white are produced.

The size of the "meshes" of the screen used vary for different grades of paper. Newspaper half-tones are sometimes as coarse as 70 to 80 lines to the inch, while in fine book and magazine work the meshes will often be as fine as 180 to 200 lines to the inch. The half-tone process very greatly improved the quality of book and magazine illustrations. It is the process by which most of the "cuts" in these volumes were made.

FINAL STEPS IN MAKING THE ILLUSTRATION

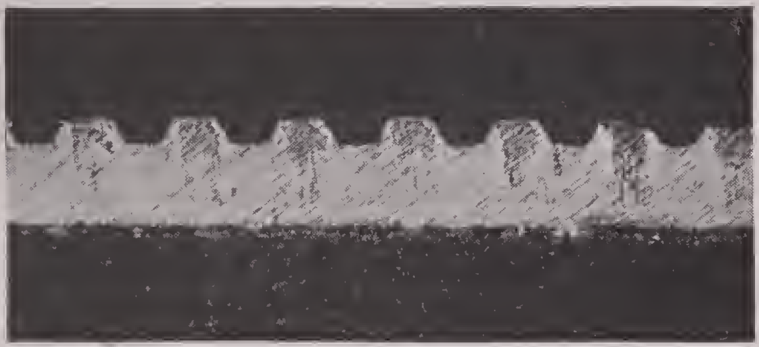


The left-hand picture above shows where the real artistry of engraving comes in. The copper plate, with the negative imposed upon it, as shown on page 1169, is now in the hands of the etcher. He also has the "copy" or original picture before him, and he is going over the plate carefully to see that every desired effect has been brought out. After the plate leaves his hands it is immersed in acid, which bites through the protecting varnish on the metal in proportion to the amount of light which has struck it, and thus etches into the metal the varying spots of white. The remaining spots will then stand up to catch ink in printing, and will thus print black wherever necessary to give the effect desired. The picture on the right shows the "routing" machine. When the plate has been etched by the acid, all blank portions not needed in the picture are "routed away" with the drill, as shown.

"Mounting"—the process on the left—is the work of a moment, compared to the other processes, for it consists merely in tacking the copper half-tone plate to a block of wood of the proper thickness for printing. The picture to the right shows the mounted plate undergoing the final inspection and trimming. In order to see it perfectly, the worker rubs it over with white chalk, and all dots which are to print black stand out. Then, with the original "copy" and a "proof" of the half-tone before him, he goes over every portion of the cut, works down rough parts, makes sure that no stray dots stand up to print in parts that should be white, and so on. When he has finished, the half-tone is ready for the printer.

"Zinc etching" is another photographic process much used to reproduce black and white drawings. In this process no screen is used in photographing the drawing onto a sensitized zinc plate. The parts of the plate which correspond to the original design are hardened as solid lines or masses. After the soluble portions are washed away, and the lines are strengthened with a chemical substance known as "Dragon's blood," the remainder of the plate is etched away, leaving the design in bold relief as in woodcuts. Half-tones and zinc etchings are often used in combination.

CROSS-SECTION OF A "HALF-TONE" CUT ENLARGED



This is the view of a half-tone when cut in two and looked at under the microscope. The saw-tooth projections are the dots which print black, and thus give the shading shown in the enlargement on a preceding page.

Photogravure and Rotogravure

"Photogravure" is a wholly different process from the half-tone. In this process a sensitized paper, called carbon tissue, is exposed under a black and white "positive," made without a screen. This paper is transferred to the copper after exposure and the parts under the clear spaces having been hardened by the action of light, the other parts can be etched through into the metal. Then the design is cut into the surface, as in etching and line engraving. A grain is obtained by first sprinkling the plate with powdered resin, made to adhere by heating. With this process there is an absence of sharp lines and dots; this results in a richness of texture which cannot be obtained in half-tone reproduction.

In "rotogravure" printing the etching is done on a copper cylinder which is put in a suitable printing press, the cylinder revolving in a trough of greasy ink. As the plate leaves its inky bath, a sharp knife scrapes away all the ink but that held in the depressions. As the cylinder revolves, it comes in contact with a cylinder of rubber which presses down hard on the exposed cylinder. The dampened paper passes between the engraved surface and the rubber blanket and the ink is forced onto the paper by the pressure of the rubber. The printed paper then goes over a steam drying cylinder. In principle this process resembles line engraving and etching rather than woodcut or half-tone printing. It is also based on the principle of the flat plate photogravure process, which it resembles in the effect produced.

Of recent years "photolithography" has grown to be one of the most important branches of commercial printing. Zinc or aluminum plates, specially treated, have been found to be very satisfactory substitutes for the cumbersome lithographing stones, and they may be used on rotary cylinder presses. The plates are covered with a solution similar to that used to sensitize plates in other photo-mechanical processes and after exposure the transferred design is covered with printing ink and the rest of the plate is treated to repel the ink.

The "off-set method," one of the processes now used in lithography, produces some rarely beautiful work, and the rotary machines do the work at much greater speed than was possible before they were invented. It is also employed on flat-bed presses. In this process either zinc or aluminum plates are prepared, as in photolithography. There are three cylinders on the rotary press, one carrying the printing plate, one with a rubber surface, and one carrying the white paper. The plate cylinder is inked and damped by two series of rollers, as used in all lithographic presses. The impression is printed by the plate onto the rubber cylinder first, which in turn prints or "off-sets" the impression on the paper carried by the third cylinder. In this process the etched plate is prepared "right-side-to," and not "reversed" as in other printing. If you stop to think a minute you will see that this must be so, because the design is printed *twice*—once onto the rubber sheet and again when it is off-set onto the paper. The off-set method prints well on any kind of paper, rough or smooth.

Three Colors that Make All the Rest

Of recent years exquisite "color printing" has been done by lithography, and the half-tone process, based on the theory that by printing successively the three primary colors—red, blue, and yellow—practically any color combination can be produced. The same principle is employed also in half-tone color printing, a separate plate being made for each of the three primary colors. By the use of colored glasses called the "light-filters" in the camera when the object or painting is photographed, only the portions in red or its allied shades appear on one negative, only the yellow on another, and only the blue on a third. When plates are made from these three negatives and printed one over another with transparent ink, the colors blend themselves into a reproduction of the original painting.

These processes cover most of the printing engraving methods used today, though there are several others that might be mentioned. All of these processes use one or the other of the three methods described in the beginning of this article. "Relief printing" is used in printing woodcuts, half-tones, and zinc etchings; "lowered surface" (*intaglio*) printing is used in real etching, line engraving, and photogravure; and "flat surface" printing is used in all varieties of lithographic work.

EN'ZYMES. These chemical substances are formed in living plant or animal cells, and they play an important part in growth, digestion, and other life processes. An unripe apple is very different in taste from one that has been ripened; enzymes have brought about the change. Bananas are gathered green and shipped to points where they do not grow; the enzymes convert the hard woody pulp into delicious food. The action of yeast and bacteria is largely due to the enzymes they produce (*see* Bacteria; Yeast). Digestion is also carried on by enzymes.

Enzymes are found in saliva and in the gastric, intestinal, and pancreatic juices, as well as in plants. They are classified according to the substances they work on. Some typical enzymes are *ptyalin*, found in the saliva, which changes starch into sugar; *pepsin*, found in the stomach, which dissolves albumin; *rennin*, also found in the stomach, which curdles milk, that is, changes its caseinogen to casein; *zymase*, secreted by the yeast-plant, which splits up sugar into alcohol and carbon dioxide.

For some time after their discovery, scientists regarded enzymes as curious substances which performed special functions in the body. As our knowledge grows, however, enzymes are taking on a new and astonishing importance, for many scientists now suspect that most, if not all, life processes—nutrition, growth, disease, and death—are chemical processes in which enzymes play a leading part.

It is known, for instance, that in addition to the digestive enzymes, the blood and even every individual cell possess enzyme properties, both for transforming foods into cell substance and for dissolving the cell substance itself. These destructive properties, however, are usually held in check by "anti-ferment" substances. These known facts have led some investigators to the opinion that life processes result from upsets in chemical balance which release either helpful or harmful enzyme properties—producing on the one hand nutrition and growth, on the other hand disease and death.

EPICTE'TUS. "I was Epictetus, a slave, maimed in body and a beggar for poverty, yet dear to the immortals." This epitaph was written for the "saint of heathendom," the Greek stoic philosopher who lived in the first century after Christ, and whose virtuous life and teachings have been respected ever since by pagan and Christian alike. Man must find happiness within himself, Epictetus taught, and not in his surroundings. "No one is a slave whose will is free." "Remember that thou art an actor in a play, and of such sort as the Author chooses, whether long or short. If it be his good pleasure to assign thee the part of a beggar, a ruler, or a simple citizen, thine it is to play it fitly. For thy business is to act the part assigned thee, well; to choose it, is another's."

The name Epictetus is merely the Greek for "acquired," which denotes his servile condition. His real name is unknown. He was born in Phrygia about 60 A.D., and when a boy he became the property of a freedman of the emperor Nero, who took him to Rome. There he managed to attend the lectures of Musonius Rufus, who acquainted him with the Stoic philosophy; and after he gained his freedom Epictetus himself began to give lessons. About 90 A.D. the emperor Domitian banished all philosophers from Italy, and Epictetus went to Nicopolis, in Epirus, where he opened a school. He continued to teach the doctrines of Stoicism until the time of his death. He wrote nothing, but talked in a familiar way with his pupils concerning the conduct of life. Arrian, his favorite pupil, took down much of his teaching, which is preserved in two treatises—the 'Discourses' and the 'Encheiridion' ('Handbook'). The year of his death is unknown.

EQUINOX AND SOLSTICE. Twice a year—once about March 21 (called the vernal equinox) and again about September 22 (called the autumnal equinox)—the sun is in the plane of the earth's Equator. The name (from Latin *aequus*, "equal," and *nox*, "night") is derived from the fact that the length of the night then exactly equals the length of the day, since the parallel rays of light from the sun, on these dates, fall upon the earth perpendicular to the axis of the earth. At the vernal equinox the earth has completed one-quarter of its revolution about the sun, and at the autumnal equinox three-quarters. Because the sun then appears to be on the Equator, the equinoxes are popularly spoken of as the dates on which "the sun crosses the Equator." "Equinoctial storms" are commonly supposed to accompany the event.

The solstices ("standing still of the sun") come at the other quarters of the earth's revolution—the summer solstice (about June 21) when the earth is at its farthest point from the sun, and the winter solstice (about December 22) when the earth is at its nearest point to the sun. The days are longest at the summer solstice and shortest at the winter solstice.

"Precession of the equinoxes" is the term applied to the slow advance from east to west of the equinoctial points, or the points at which the Equator and the ecliptic intersect each other. The change is so slow that it takes about 25,800 years to make a complete shift around the ecliptic. (*See* Earth; Sun and Solar System.)

ERICSSON, JOHN (1803–1889). This Swedish-American inventor and engineer, who became famous through his construction of the ironclad *Monitor* (*see* Monitor and Merrimac), was not, however, a man of one invention, nor was he unknown before that memorable day in March 1862. As a boy in Sweden he showed a mechanical bent very early—so early that at 12 years of age he was apprenticed as a draughtsman. From 1820 to 1827 he was in the Swedish army, where his excellent military maps won him a captaincy. Then he obtained leave to go to London, and in partnership with John Braithwaite he competed for a prize offered for a steam locomotive by the Liverpool and Manchester Railway Company. The competition, however, was won by Stephenson instead of Ericsson. But the latter went on with his work of inventing, and completed various marine inventions. He built a new kind of naval engine which was to be placed below the water line, and won a prize of $20,000 from the British admiralty for the invention of a screw propeller. In 1838 he designed the engines and propeller used by the first vessels to cross the Atlantic in regular steamship service.

The United States government became interested in him about this time and ordered an iron vessel at a British shipyard to be fitted with his screw and engines. Ericsson followed the boat across the Atlantic and set himself up in New York in 1839 as a builder of ships. His struggle was long and hard, but finally his many useful inventions gave him a considerable fortune. His invention of the *Monitor*—that ironclad "cheese-box on a raft," with its revolving gunturret—revolutionized naval construction. Later he became interested in torpedoes and motors driven by solar heat.

ERICSSON
Inventor of the 'Monitor'

Ericsson had become a citizen of the United States in 1848; but when he died, in 1889, his body was, at his request, taken to Sweden on a Swedish man-of-war, where it was buried with many honors. In Stockholm, Sweden, and in New York City, monuments have been erected to his memory.

ERIE, LAKE. So treacherous is Lake Erie, and so long is its tale of shipwrecks in earlier days when vessels were smaller and less seaworthy, that it has been called "the marine graveyard of the Inland Seas." It is the shallowest and stormiest of the Great Lakes, with its surface 573 feet above sea-level and its greatest depth only 210 feet. Fourth in size of the five Great Lakes, covering about 10,000 square miles and 245 miles long, it boasts four out of the seven greatest lake ports—Detroit, at the western end where the Detroit River, Lake St. Clair, and the St. Clair River join it with Lake Huron; Buffalo at the eastern end where its waters roar over Niagara Falls and down the rapids of the Niagara River into Lake Ontario, 326 feet lower in level; and Toledo and Cleveland, on the Ohio shore.

The Battle of Lake Erie, fought Sept. 10, 1813, marked a crisis in the War of 1812. On one of the islands opposite Sandusky is Put-in-Bay, from which Commodore Perry set sail with his little fleet. (*See* Great Lakes.)

ERMINE. A quick, restless, brave, and bloodthirsty little animal is this member of the weasel family, related to the mink. It has a slender body, about ten inches long, and short legs. It runs swiftly and climbs and swims well. Making its home among rocks and stones, it feeds on smaller animals such as birds, rats, mice, and chickens, sucking the blood of its prey. It is found in Europe as far south as the Alps and in Asia and North America.

The ermine owes its interest chiefly to its fur. In summer this is reddish-brown above and yellowish-white underneath and the animal is then often called the "stoat." In winter the fur changes to a beautiful white, all except the tail, which has a black tip. The ermine fur used in trade is the white fur with the black tips inserted in regular order. This was formerly used in the linings of the robes of kings and queens and is still used for the robes of judges in England. The pure color of the fur has made it the symbol of the purity which should attach to the office of judge. The best ermine furs are imported from Siberia, Lapland, and the Hudson Bay territories. Scientific name of Russian ermine, *Putorius erminea.*

GROWER OF THE "ROYAL ERMINE"

This little weasel-like animal produces one of the most highly prized furs we know. Its coat changes color with the seasons, but the white "winter coat" is the one which fashion fancies.

ESKIMOS. When explorers first reached the Arctic lands, they found the Eskimos living much as some of them do today. Then, as now, they were scattered all along Labrador and the north coast of America, on the Arctic Islands, on Greenland, and on a part of the Siberian coast. They are closely allied to the natives of the Aleutian Islands, off the Alaskan coast; and many scientists believe that they are of the same stock as the American Indians, whom they resemble in their straight black hair, obliquely set eyes, and brown skin. Although they are so widely scattered, all Eskimos are extraordinarily alike in language, habits, and appearance. Some tribes, in districts farthest south, have adopted many civilized ways from the white people of the settlements. They learn readily and show marked intelligence. They are cheerful and merry, fond of music, and excellent mimics. Generosity, hospitality, and friendliness to strangers are characteristic traits. Warfare is almost unknown to them. They take good care of the children and the aged, and share their food with one another.

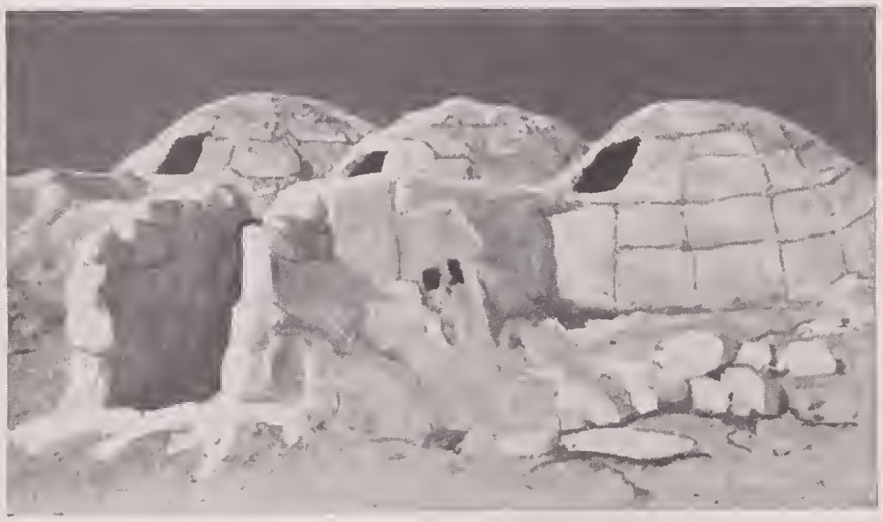
Although the Eskimos cover such an expanse of territory, they probably do not number over 40,000. Their villages are small, with from 25 to 200 inhabitants. There is no chief and no form of government. Each tribe has its own territory. Sometimes all the people of a village will be found living in a community igloo, where all share alike. Most of the Eskimos of West Greenland, Labrador, and Southern Alaska have accepted Christianity. The name "Eskimo" was given them by their Indian neighbors and means "eaters of raw flesh." Their own name for themselves is "Innuit," meaning "men," or "people."

A Day's Visit in ESKIMO LAND

TODAY you shall be the guest of Kessuh, the Eskimo boy, whose home is in the Great White North. Of course you have heard of this strange brown-skinned race—who live so much of the year without sunlight, who drive dogs instead of horses, never eat butter and bread, and whose men and women dress exactly alike. Now you are to see them for yourself.

Kessuh has brought you a suit of furs, such as all Eskimos wear, for your sweater and overcoat will never keep out the biting cold of a Greenland winter. The shirt is made of the breasts of eider ducks. There are two pairs of trousers—one of seal-skin made with the fur side in, and an outer pair of reindeer-skin with the fur side out. The jacket is of bear-skin, with a hood that fits close about your face. When, with all this, you have put on the high seal boots and fox mittens, you feel very much of a zoo!

A DESERTED VILLAGE IN ESKIMO LAND



This is a small Eskimo winter village of three huts. You see they have a common entrance, for it is not well to let in too much air in Eskimo land. The openings in the roof are not windows, but are the holes which tell you the village is deserted. They were made for taking out household goods at the time of leaving the winter houses of snow blocks for the tent homes of the summer hunting season.

Now you are off for the village. The long winter darkness has begun, and although by your watch it is mid-morning, you travel by starlight, for the sun has disappeared for six months from the Arctic regions. In the dim twilight you look in vain for streets. You see only a few scattered snow-covered mounds.

Kessuh stops before one of the mounds and motions you to follow. On your hands and knees you creep through a stuffy tunnel. This is the hallway to Kessuh's house or "igloo." You find that it has only one low smoky room, half under ground, a sort of cave walled up with rocks and chinked with moss and earth. Sometimes when on a journey, the Eskimos build their conical-shaped igloos of rectangular blocks cut rapidly from the snow or ice.

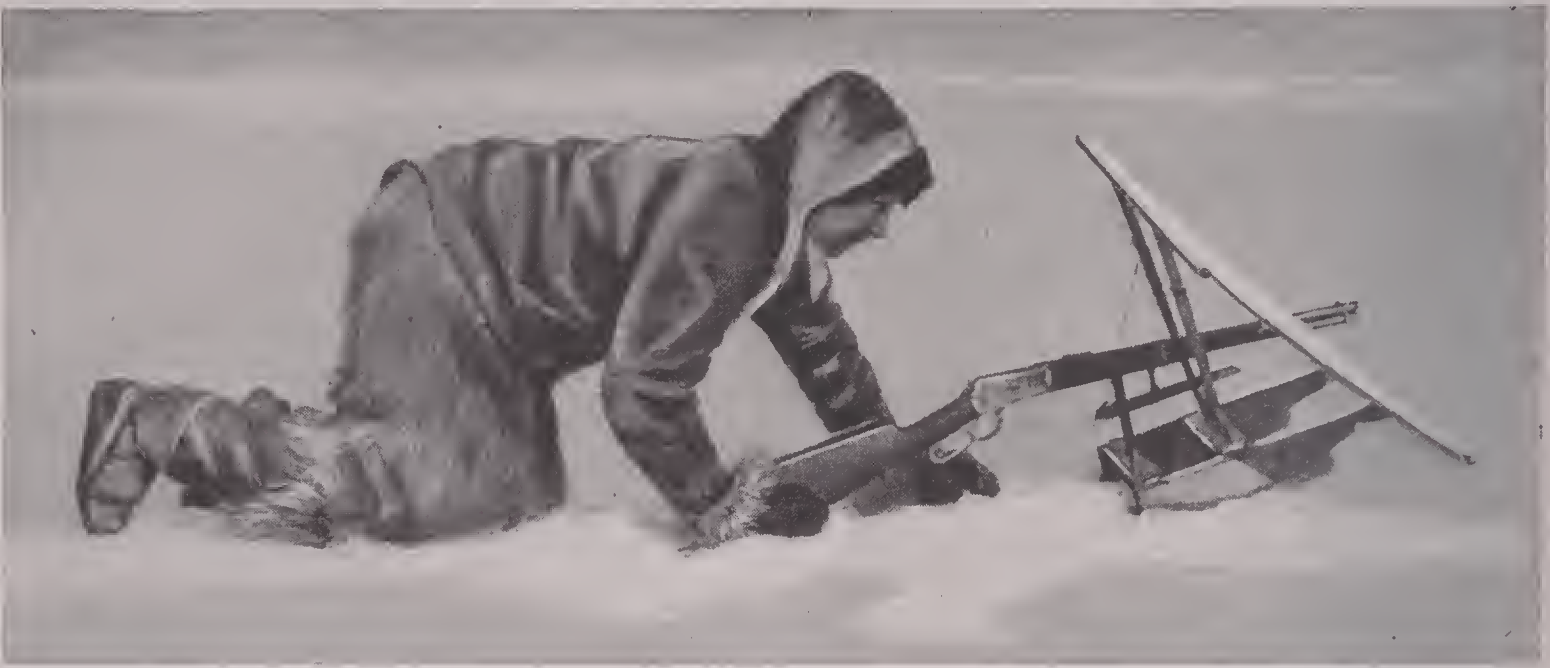
This Little Cook Stove Lights the House

The room is lighted by a strange lamp, a rude kind of basin shaped from soapstone and filled with whale or seal fat. The burning wicks of twisted moss give out heat as well as light, and over this lamp-stove Kessuh's mother is boiling his dinner. But Kessuh does not care much for cooked meat; he is just as happy with a piece of raw frozen fish or bear flesh.

Kessuh's sister is sewing bird skins together to make a shirt. Her bone needle looks clumsy, and she uses sinew for thread; but she makes a very neat seam.

The father is making a bow from the rib-bone of a whale. He is stringing it with a thong of fox-hide. Now he lays it aside to eat a great piece of raw flesh which the mother has cut from a half-skinned seal that lies on the earth floor. He is a short stocky man, not more than five feet four inches high. In his furry clothes he looks like a roly-poly bear, for his walk is almost a waddle.

CAMOUFLAGE AND STRATEGY OF THE SEAL HUNTER



This young Eskimo hunter of Etah—the most northerly village in the world—is crawling up behind a seal. He is partially hidden behind a white screen and pushes his rifle along ahead of him on runners. The Eskimos show themselves very ingenious in many things they have invented, and you see how quickly they apply this inventive faculty in the use of modern weapons. Of course such Eskimos are very far removed in the ways of living from the primitive tribes described in the story.

On one side of the room is a low platform made of bones. You follow Kessuh to the platform and there among the furs that cover it is an Eskimo baby, with only its head sticking out of a bag of feathers. Kessuh lifts it up and rubs his nose against its funny little flat nose. The sister leaves her sewing and comes to rub noses with the baby too. This is the Eskimo way of kissing. The mother seeing the baby awake brings a handful of seal blubber. She feeds the baby a bit, and he crows and reaches for more. Kessuh and his sister look longingly at the greasy tid-bits. Their mother gives them each a piece and they smack their lips over it. She offers you one and when you shake your head and say, "No, thank you," Kessuh looks surprised. He thinks it very strange that you do not like their Eskimo "candy"!

The mother takes the baby up and puts it into a long fur hood at the back of her coat. Here it rides contentedly as she goes about her work. She is shaking and rubbing some wet skins that hang on a drying-rack, which also is made of bones. On this same rack are sets of strong hide straps. These you think must be the dog harness. You remember that it has to be kept out of reach or the dogs would eat it. They are always hungry.

Ka-Ka-Chee-Ah (that's his name) is a skilful hunter of seals, but he uses the primitive weapons. He has in his left hand his harpoon, with which he spears the seal, while in his right is what is known as the "killing iron" for dispatching the animal.

The father has finished his seal-meat and lies down on the platform-bed. The mother comes to him with hands full of small pieces of flesh and blubber. As he lies on his back she feeds him until you wonder how he can possibly swallow more, but he is still eating greedily when Kessuh takes up the harness and beckons you to come.

You are glad to leave the close ill-smelling room. You find the wild wolfish dogs lying in the tunnel hallway. They follow Kessuh, crowding and yelping about him, as he goes to the *cache,* a snow cave, and takes out pieces of frozen walrus meat for them. The moon is now shining and you watch Kessuh and his sister dig the sledge out of the snow that has hidden it. You examine the low runners and cross pieces, so skilfully made of bone. It is very light but it is also very strong, as you find when wrapped in a fur robe you go for a swift ride over the white fields. Kessuh sits in front and guides his six dogs with a long leather whip as easily as you turn your pony team.

If you could understand Kessuh's language he would tell you many thrilling tales as you glide along. He would speak of the bright summer when for whole months together the sun does not set on his Arctic home, and the ice breaks up in the bays and inlets. Then comes the exciting times when the caches are filled with game for winter food. This Arctic summer is one long hunting party. The Eskimos leave the unwholesome igloo and live in "tupeks" or tents of skin, which they can carry about with them as they search for game.

AN ESKIMO MOTHER AND BABY

Although this Eskimo mother loves that baby so much, she never kisses it, of course; she rubs noses with it. Mother and baby are standing in front of an Eskimo house made of blocks of solid snow, but their clothes come from civilized lands.

What a Lot Kessuh Knows about the Out-of-Doors!

Kessuh could tell you where the eider duck fills her down-lined nest with eggs, where the great white owl makes his home, where the little auks gather, and how, hidden among the rocks, he catches hundreds of them in his homemade net. He could tell you how, in his wonderful little "kayak" or waterproof boat made of skin stretched over a bone framework, he helps land the great whale that the men of his tribe have harpooned. You would like to see this harpoon. The point is detachable, and to it an inflated seal-skin bag is fastened. This acts as a drag on the wounded animal, and when it is dead causes its body to float so that it is easily located by the hunters. Kessuh uses this same weapon when he surprises the walrus asleep on the ice, or when he sits patiently by the air hole of the seal until, with a sudden stroke of the spear, he makes sure of seal blubber and a warm skin for the next winter. Then too you might hear an exciting bear story, for a bear hunt with the crude instruments of the Eskimo is risky business.

But you would find it hard to talk with Kessuh, even if you knew his language. You would find that he has no word for school, church, train, automobile, book, pencil, and many other things of which you speak every hour. He knows only of ice and snow and of such animals as live in the very coldest parts of the world. He may have a word for store, because in some parts of the Arctic regions there are trading posts or settlements, where the more progressive Eskimos go to trade furs for needles, knives, tools, and the white man's food.

Saying Goodbye to Kessuh

When your ride is over, Kessuh leaves you at your ship. You want to give him a present. There is nothing in the world he would like so much as your pocket knife, for he has never seen one like it. When you slip it into his hand and make him understand that it is for him to keep, he is so happy you are afraid he is going to rub noses with you. You watch him drive away, feeling very glad that you are not going back with him to sleep in his igloo.

ESPERANTO. Many attempts have been made to invent a new universal language to serve the purpose that Latin served in the Middle Ages. Volapük, which was given to the world in 1879 by Johann Martin Schleyer, a German priest, attained a measure of success, but just when its triumph seemed assured, dissensions arose among the leaders.

Meanwhile, however, Esperanto was developed and it soon outstripped all other artificial languages. It was the work of Dr. Zamenhof, a Russian physician and scholar, who presented it to the public in 1887, the name Esperanto coming from the Spanish for "hope." It uses sounds and words common to all the European languages, dropping what is special to any one of them. The grammar is very simple, and many students have mastered Esperanto in a few months. About 200 periodicals and some thousands of books have been printed in Esperanto. Here is a stanza from a poem by its founder, with an English translation:

Sur neutrala lingva fundamento,	On a neutral lingual foundation,
Komprenante unu la alian,	Understanding one another,
La popoloj faros en konsento	The peoples shall form in agreement
Uno grandan rondon familian.	One great family circle.

ESSAY. It was in the tower of an old castle inFrance, in the year 1571, that the first "essay" was written. Michel de Montaigne, a cultured French gentleman, had retired there to forget the cares of the busy world, and to read and meditate in quiet. A desire to "preserve his memories" and "clarify his reflections" led him to write. He called the little book, which he began at this time and published in 1580, "Essais"—meaning "attempts" or "trials."

The term essay, which was soon adopted in England, thus suggests that the author is merely touching upon the subject in hand, and not treating it exhaustively; giving a short comment rather than a complete and formal discussion, as in a "treatise" or "monograph."

"Myself am the groundwork of my book," said Montaigne, and indeed it is mainly the author's personality as he reveals it to us that makes a good essay.

Unlike the novel or the short story or the drama, the essay does not aim primarily to create characters and through them to tell a story. It speaks directly to the reader, giving the author's views on customs or happenings or people, on art, on books, or on life in general. It may teach, argue, persuade, arouse emotion, or merely amuse. Its subject may be almost anything, from 'Easter Bonnets' to 'Grand Opera'.

Though French in origin, the essay form appealed especially to the English. After Montaigne, an Englishman, Lord Bacon, was the next great writer of essays. He called his essays "certain brief notes set down rather significantly than curiously" and spoke of them also as "dispersed meditations." As a matter of fact, his essays are very compact and written with painstaking care. They are somewhat more formal and less personal than those of Montaigne.

When magazines and newspapers began to be published, the essays became especially popular. In two periodicals, published in London in the beginning of the 18th century, called *The Tatler* and *The Spectator*, Addison and Steele wrote essays commenting on the life of the time, the most famous being the Roger de Coverley papers.

Then in the 19th century came one of the most delightful of essayists—Charles Lamb, who, though he hid under the pen name of "Elia," revealed his whimsical lovable personality as few writers have done. His humorous 'Dissertation on Roast Pig' and his tender and pathetic 'Dream Children' are inimitable. At about the same time Macaulay wrote essays of a very different type. They are very carefully organized and noted for the clearness of their style and the splendor of their diction. Macaulay's essays, that on Milton for example, may be taken as typical of the formal essay, as Lamb's 'Essays of Elia' are representative of the familiar or informal essay.

Of the essayists who followed, some leaned more toward one type and some toward the other, but each wrote in his own way. Hazlitt, Carlyle, Ruskin, Thackeray, Matthew Arnold, and Stevenson are among the greatest essayists in England. In America Washington Irving in his 'Sketch Book' and Oliver Wendell Holmes in his 'Autocrat of the Breakfast Table' used the essay form with great success, and Emerson's ethical essays became especially famous.

Today we meet a form of the essay every day in the editorials of the daily newspapers, while in our magazines the essay still occupies a prominent place and for some readers has a stronger appeal than the more exciting short story.

ESSEN, GERMANY. Essen is situated in the basin of the little Ruhr River, the rich coal region of northwest Germany, but up to 1811 it was a place of no importance, having only a few thousand inhabitants. In that year Friedrich Krupp opened a blacksmith shop in Essen with two workmen, and when the iron and steel industry of Germany began to develop in the middle of the century, Essen speedily became the Pittsburgh of Germany.

At the opening of the World War, the town had grown to more than 300,000 people, and was the home of the colossal Krupp steel works, the most extensive in Europe, which in times of peace manufactured railway equipment and other steel products, but which were chiefly famous for their monster cannons and other military engines of destruction. Although forbidden to be associated with any trade union or socialist organization, the firm's 70,000 employees were well provided for with pensions, attractive dwellings, schools, stores, libraries, and various other measures for the improvement of living conditions, which have made Essen known as a model industrial town. During the great conflict Essen was the center of Germany's most feverish activity; but the peace terms demanded the dismantling of the munitions factories. This restriction and the general disorganization following the war seriously impaired Essen's former prosperity and importance.

In contrast with its modern martial aspect, Essen was originally noted as the seat of a Benedictine nunnery. Its cathedral, founded in the 10th century, is one of the oldest in Germany.

ESTATES-GENERAL. When Philip the Fair of France needed help in his struggle with the pope in 1302, he called together representatives of the nobles, of the clergy, and of the townsmen of France, the three estates or classes, in order to gain their aid. Although there were meetings of similar partial groups in the preceding ten years, this date may be taken as the first meeting of the Estates-General of France, which in the beginning corresponded roughly to the Parliament of England, not yet 50 years old.

The French monarchy was more firmly fixed in power by the unfailing succession of the Capetian line, and the Estates-General never gained the right to make laws as the English Parliament did. The three estates never fused and the lower or third estate always lacked that leadership from the upper classes which the lower clergy and barons gave the Commons in England. Neither was there in France that tradition and practice of local self-government which prevailed in England. During the Hundred Years' War (1337–1453) the Estates-General could frequently force the king to do as it wished by refusing him money to carry on the struggle, but it as often forfeited public respect by favoring civil strife or even by allying itself with the English invaders. Near the close of the war (1439) it granted a land tax, the *taille*, from which the nobles were exempted. This favored and powerful class no longer had a good reason, as did the barons of England, for allying themselves with the Commons, and there was therefore no opposition when the king chose to consider such grants perpetual. As a result the king became independent. He had plenty of revenue, he had a standing army, he dominated the clergy and dispensed favors to the nobles, and so had little need of the Estates-General. Successive kings and great ministers found its opposition to royal power increasingly easy to break.

For 175 years (1614–1789) the representatives of the three estates were not summoned to consider the affairs of the kingdom. But in 1789 the treasury was empty, and Louis XVI was forced as a last resort to call this almost forgotten body together again. When it met, May 5, 1789, the representatives of the third estate, equal in numbers to the other two, refused to vote according to the old method, each estate casting one vote. They insisted on voting as individuals. Led by the bolder spirits they declared themselves the National Assembly, and on June 20, 1789, they took the famous "Tennis Court" oath not to disperse until they had given France a constitution. This bold attitude showed clearly that a revolution was at hand. (*See* French Revolution.)

The name estates-general was not uncommon in medieval Europe. In Spain there were four estates or classes in the assembly. In Holland the name States-General is still applied to the legislative body of that kingdom. It is composed of two houses, the upper elected by the provincial assemblies and the lower chosen by the people.

The JEWISH MAIDEN *who Became* QUEEN *of* PERSIA

ESTHER. In a beautiful Bible story we are told how the mighty king Ahasuerus of Persia chose from among all the maidens in his kingdom the one he deemed fairest to be his Queen. This was a Jewish maiden named Esther, although the king knew not who were her people or her kindred. Her father and mother were dead and she had been reared by her cousin Mordecai.

But shortly after Esther became queen, a great disaster threatened her people. A haughty man named Haman had been raised to the highest office in the kingdom, and he demanded that all should bow down before him. Mordecai refused to bow down and for this Haman hated him so that he wished to destroy not only Mordecai himself but all the Jews. The king allowed Haman to do what was good in his own sight and the wicked officer issued a decree that on a certain day all the Jews, young and old, throughout the kingdom should be destroyed.

When Mordecai heard the dreadful news he begged Esther to intercede with the king. Esther dared not approach the king, for there was a Persian law that anyone who entered the presence of the king without being called must die, unless the king showed mercy by holding out his golden scepter. But at last thinking that she may have been raised to her high station for the very purpose of saving her people, she said, "I will go in unto the king, and if I perish, I perish."

Clad in her royal robes, Esther approached the king's inner court. Ahasuerus, seated on his throne, was so moved at sight of her that he held out his golden scepter and bade her approach. "What wilt thou, Queen Esther?" he asked. "What is thy request? It shall be given thee, even to the half of the kingdom." Esther's only request was that he and Haman should come that day to a banquet that she had prepared for them. When they were banqueting, the king again asked Esther if she had any request, and she asked the king and Haman to come again tomorrow to the banquet; and then she would tell the king what she desired of him.

Haman Has a Gallows Built

Haman was very much elated at being invited to feast with the king and queen. But when he saw Mordecai, he was so filled with wrath, that he caused a gallows to be made on which to hang him.

Now some time before this, Mordecai, as he sat at the palace gate, had chanced to overhear two of the royal chamberlains plotting against the king's life. He told Esther and she warned the king. Thus the king's life was saved, and so it was written in the book of records. The night before the second banquet, the king could not sleep, so he called his attendants to read to him from the records. And they read how Mordecai the Jew had saved the king's life. "What honor has been done to Mordecai for this?" asked the king. "Nothing has been done for him," was the reply. While they were speaking Haman came into the outer court. He wished to ask the king to hang Mordecai on the gallows that he had prepared. The king bade him come in and said to him, "What shall be done unto the man whom the king delighteth to honor?" Then Haman thought to himself, "I am the man whom the king wishes to honor," and he replied, "Let the man whom the king delighteth to honor be arrayed in the royal apparel and the royal crown be set upon his head, and let him be placed on the king's own horse; and let one of the king's most noble princes lead him through the city and proclaim before him, 'Thus shall it be done to the man whom the king delighteth to honor.'"

Haman is Hanged on His Own Gallows

Then said the king, "Make haste and take the apparel as thou hast said, and do so even to Mordecai the Jew." And so Haman was forced to array the despised Jew in the king's robes and lead him through the city, proclaiming before him, "Thus shall it be done to the man whom the king delighteth to honor."

The next night when they were at the banquet, the king said to Esther as before, "What is thy petition? and it shall be performed even unto the half of the kingdom." Then Queen Esther said, "If I have found favor in thy sight, O king, spare my life and that of my people, for we are to be slain." "Who is he that dares to do this?" said the king. And Esther answered, "Our enemy is the wicked Haman." The king arose in his wrath and went into the palace garden, and one of the servants showed him the gallows that Haman had built for Mordecai. "Hang Haman thereon," commanded Ahasuerus. And so they hanged Haman on the gallows that he had prepared for the execution of Mordecai.

Mordecai was raised to the highest office in the kingdom, and the day that was to have been a day of sorrow to the Jews was made a day of joy and gladness. So is its anniversary to this day, for it is still celebrated as the festival of Purim, and on this day the Book of Esther, which tells her story, is read in their synagogues.

ESTHO'NIA. Bordered on the north by the Gulf of Finland and on the east by the Baltic Sea, Esthonia is the most northern of the Baltic Provinces which, until the close of the World War, formed part of the Russian Empire. It is a low flat land, with many lakes, streams, and marshes. The climate is very severe—cold and raw in the winter, and hot in the summer. Agriculture and livestock raising are the principal occupations of the people, who are industrious and enterprising, and who, unlike many of their neighbors, use the most modern methods of farming. Rye, barley, hay, oats, and potatoes are the leading agricultural products, and enough cattle, sheep, and hogs are raised to allow for the export of meat. The manufacture of iron and steel has reached a considerable development.

The Esths, or Esthonians, who make up about 95 per cent of the population, are a Finnish people, with oblique eyes, broad faces, and low foreheads. They speak a language much like that of the Finns themselves, a language which is Mongolian and not European in its relations. In religion they are Protestants, in spite of the persistent attempts of the Russians to convert them to the Greek Catholic faith. The other inhabitants of the country, who have mingled more or less with the Esths, are Germans, Russians, Lithuanians, Swedes, and Jews.

When the Esthonians first appeared in history, they were a primitive, warlike people, who lived largely by piracy. The country was first conquered and christianized by the crusading Order of Teutonic Knights. It passed into the hands of Sweden in 1561; and in 1721 was won for Russia by Peter the Great. Thenceforth it remained under Russian rule until the collapse of the imperial government in 1917.

Reval, with a population of about 160,000, is the capital and chief seaport. Area of Esthonia, about 20,000 square miles; population, about 1,400,000.

ETHER. You know that the earth is surrounded by a layer of air called the "atmosphere." But what lies beyond that, in the immense spaces between the earth, the moon, the sun, and the stars? Scientists have decided there must be "something" in those spaces, and they have called that something "ether." (For "ether," the chemical used in surgical operations, *see* Anesthetics.)

According to the scientists, this ether of space is everywhere. It is a substance finer than any known to our five senses, and it extends beyond the farthest star and penetrates even the densest bodies. It exists in a ball of the toughest steel like water in a sponge; but you can't squeeze it out as you can water from a sponge, for as long as the steel ball takes up the least bit of space, it takes up just that same amount of ether. The nature of ether is closely related to the theories about the constitution of matter (*see* Atoms and Electrons).

It has been discovered that it takes light about eight minutes to travel from the sun to the earth. What becomes of it after it leaves the sun and before it reaches the earth? If there were absolutely nothing along the 92 million miles between us and the sun, neither light, nor radiant heat, nor anything else could travel through that space. Sound, for instance, travels through the air in waves. If there were no air, there would be no sound (*see* Sound). The same is true of light and radiant heat, except that they do not travel by air waves, which are much too slow for them, but by waves in what we have called the ether. This method of travel is called "radiation" (*see* Heat; Light). Certain forms of electricity also travel through the ether by radiation (*see* Wireless Telegraph and Telephone).

ETHICS. We are all constantly questioning our own acts and those of our neighbors, asking ourselves two general sorts of questions — "Is it wise?" or "What ought I to do?" Whether it is better to write with a pencil or a pen is usually a matter of expediency alone, and belongs to the non-moral sphere. But whether I shall speak truly or falsely is a distinctly moral problem and belongs to the field of "ethics," that branch of philosophy which deals with human action in so far as it is considered right or wrong, good or bad. Ethics attempts to systematize the common expressions of opinion, showing the types of moral problems and the methods of their solution.

You might, perhaps, suppose that there is no difficulty in deciding between right and wrong; and there is a certain field in which custom or tradition furnishes an undisputed standard. We know that we should not go out and murder our neighbors or steal their property; and the only moral problem that arises in such instances is the practical one, whether we will do what we know is right. But there are cases in which we do not know what we ought to do. Suppose a manufacturer wants to pay his laborers a living wage but finds himself in competition with other people who do not. If he raises his wages he goes into bankruptcy. What shall he do? In solving such problems ethics insists that we must act with reference to all the facts involved. We must see all the things that are worth while, and act with reference to all these "values."

The term "ethics" is derived from a Greek word meaning "manners," "customs," or "habits," just as "morals" is derived from a Latin word with a similar meaning. Some philosophers — those of the naturalistic school — believe that our present ethical system is the outgrowth of very slow and unconscious alterations of these habits and traditions. Others, however, believe that standards are not truly ethical unless they are the result of reflection and conscious criticism of these habits and customs. (*See also* Philosophy.)

ESTHER PLEADING FOR HER PEOPLE

They had some very strange ideas, didn't they, those old kings of Persia? Even the king's wife couldn't call on him without special invitation. To do so meant that she was likely to be put to death for disregard of kingly dignity. Esther knew all this, but she decided to take her life in her hands and approach Ahasuerus on behalf of her people. As we know, the king was so moved at sight of her that he held out his golden scepter, which meant that her life was spared and her people saved. The Jewish festival of Purim, which corresponds to the old Persian New Year's festival, and which is observed early in March, was instituted to commemorate the defeat of Haman's plot to massacre the Jews. The Ahasuerus of the story of Esther is the Xerxes of history.

contained in the Easy Reference Fact-Index at the end of this work

LITTLE TALKS ON GREAT THINGS

by Arthur Mee

GOOD MANNERS

ONE of the first stepping stones to a happy life is what we call good manners, and they are within the reach of all.

The best life that we can live is the life of love, a warm out-pouring of the heart toward others and a natural drawing of the hearts of others toward ourselves. There can be no real success unless our hearts are right with others, unless our lives draw others to us.

How can we start most easily and practically on the way to this goal? Some people would give very lofty advice at once, difficult to follow, but the easiest to understand is the best, and it is this: Try to get good manners, and to understand *why* they are good.

Some will think it is far too simple, but we will try to prove that they are wrong. What about cleverness, genius, ambition? they will ask. What about strength of will, determination, perseverance, courage? All are very praiseworthy, if well used, and we are not condemning them; but there is a better start.

A very wise and good Irishman, Prof. W. E. H. Lecky, wrote a book of advice which he called 'The Map of Life', and in it he said that on the way to real success "good manners and tact, allied with sound judgment," would help us more than "intellectual qualities or imperious strength of will."

That is not what many people, who would like to be right, really think. They imagine that the finest thing of all is to command the world; to win a way by strength and power; and they wish that they may be clever, educated, forceful, rich, and hold a high position.

Now, very few people can do that; and they are not the happiest people when they have done it. The better course is to win a way by attractiveness which comes naturally out of the heart. That way is open to all of us, and the first step is good manners.

If we are to prove our claim for the great importance of good manners we must begin by understanding what they are.

They are not a system of behaving that may be learned from a book of etiquette, though outward manners are important, and usually extraordinarily wise. Conventional manners —that is, the right thing to do according to social notions and practices—are not mere fashions, adopted like the changing forms of dress that last only for a brief season; they are the wisdom left from the experience of generations. Their object is to tone down whatever might be objectionable to other people, and to make our living with one another smooth and agreeable. So etiquette is good, but it is not actually essential to good manners.

Good manners do not come out of books on etiquette that tell us how to behave, though there is a great deal of such knowledge it is well we should have absorbed completely. They are born out of our own hearts. They spring from quick sympathy for others. They are our actions when we are warned against doing what would be objectionable to other people; and when we follow an impulse to do, in a natural way, what would be felt by other people to be kind and graceful.

Good manners are the habit of being honestly thoughtful in making others happy and at ease in our presence, and not thrusting ourselves carelessly or roughly or selfishly upon them. Considerateness is their keynote.

Some of the best manners in the world are shown by people who have never had a lesson in formal manners in their lives, quite simple country people, with but little education, yet self-possessed, and extraordinarily quick in feeling what is exactly the right thing to say and do under circumstances that are new to them. Their hearts speak, and speak with truth, kindness, and dignity.

Now, apply this view of good manners—the product of the thoughtful heart—to the career of a boy or a girl, and you will see how extraordinarily helpful it is. For good manners win a welcome everywhere. Wise Sir Francis Bacon said of them that they "are letters of perpetual recommendation," and Emerson, a still wiser seer, said, "Give a boy address and you give him the mastery of palaces,"—meaning that right manners will carry him anywhere.

There is but one way to the acquirement of really good manners, and that is by having the kind and considerate heart which suggests instinctively the kind and considerate act. Sham manners are worse than honest bluntness; "fine" manners often only conceal insincerity. But really good manners are the best of all the starts in life, and they never wear out, but become ingrained in our lives.

Some DO'S *and* DONT'S *of* ETIQUETTE

A Review of the Essentials of Good Manners, Including Conduct at the Table and in Public Places—The Correct Manner of Writing Formal Letters

ETIQUETTE. As is explained in the accompanying 'Little Talk on Great Things', well-bred persons tend instinctively to follow the code of good manners which we call etiquette. Its rules govern our behavior in social intercourse and in business life. It is etiquette that teaches us how to conduct ourselves at the table; the usages to be followed by the host and hostess and the guests at a dinner party or other entertainment; the correct clothes to be worn by a man or woman at a formal dinner, ball, or reception and at an informal luncheon or tea, or on the street. It teaches the correct usage in introducing people to one another—that a young person must be presented to an older one, and a man to a woman. It sets forth certain forms for formal invitations and for accepting and refusing them, certain forms of address for business correspondence, and others for social correspondence. In fact, etiquette prescribes a thousand and one little niceties of behavior which go to make up the conventional "good manners" that rule in any given society. There is nothing absolute in these rules, and they vary greatly in different times and places. The groundwork of etiquette is always thoughtfulness for others, courtesy, and a gracious manner.

Various helpful manuals of good social usage have been published, among them 'Boys, Girls, and Manners', by Florence Howe Hall; 'The Book of Good Manners—Etiquette for all Occasions', by Mrs. Florence Kingsland; 'Manners and Social Usages', by Mrs. Mary Elizabeth Wilson Sherwood; and 'Everyday Etiquette, a Practical Manual of Social Usages', by Marion Harland and Virginia Terhune Van de Water.

Good Manners at the Table

ALL your life you will sit at table with other people three times a day. If your table manners are offensive, your family may overlook the matter, but well-bred acquaintances will never ask you to eat a meal with them. So here are some useful points of table etiquette.

Sit upright at the table. Do not slide down on your spine nor sprawl forward on your elbows. Lay your napkin across your lap; don't tuck it in your neckband or button-hole.

Don't fidget with your knife and fork, drum with your fingers, or tap your foot on the floor. These are nervous habits that annoy other people. Don't make a noise in eating and drinking or take enormous bites or chew with your mouth open. To eat fast looks greedy and is bad for the digestion. Don't bite into a whole slice of bread and butter. Break the bread into suitable pieces for eating and butter each piece separately. Don't bend over your plate and give the effect of shoveling your food into your mouth, and don't reach for things. Ask the waitress or the person nearest the dish to pass it, saying: "If you please."

Never put a knife blade into your mouth. The dinner knife is used only for cutting food or for spreading butter on bread. Soup, watery vegetables, and fruit sauce, berries, grapefruit, halved oranges, cantelopes, ices, and soft puddings are eaten with a spoon. Bread, small dry sandwiches, crackers and cheese, small cakes, many solid fruits, nuts, olives, pickles, celery, radishes, and corn on the ear are properly taken up in the fingers. Practically everything else is eaten with a fork—even peas, soft layer cake, club and mayonnaise sandwiches. A good rule is: When in doubt use a fork if possible.

In eating soup, dip the edge of the spoon that is farthest from you to fill it, and take the soup from the other side, not from the tip. Don't tip the plate to get the last spoonful. The butter spreader when not in use is laid on the bread-and-butter plate, the teaspoon in the saucer. Don't litter the table-cloth about your plate. Put bones, potato skins, and other refuse on your bread-and-butter plate or at the side of your large plate.

If you wish a second helping of anything, ask for it. A delicate appetite isn't fashionable, and a hostess is flattered when people like the food she has provided. Of course it is very bad manners to criticize the food or cooking. You need not eat anything you do not care for, or that you know is not good for you, but let it be served to you and say nothing about it. Children especially should be taught not to say that they "do not like" something that is on the table, or be surprised at an unfamiliar dish, or ask for something that is not served. It is a mark of social experience to have a taste for a variety of foods and styles of cooking.

Table-talk is a fine art. Because unpleasant thoughts interfere with the enjoyment and digestion of food, disagreeable topics must not be mentioned at table. Table-talk is light, bright and crisp, never very serious, and should be as general as possible.

When you have finished eating, drop your napkin unfolded beside your plate, since at a dinner party a napkin is not supposed to be used again; and lay your knife and fork on your plate, side by side, not crossed. If you are obliged to leave the table before the others do, ask the hostess to excuse you. At home that's mother, remember.

The Etiquette of Dinner Parties

RULES for setting the table change from time to time, so that it is not possible to give many directions for laying the board. Fine white table-cloth and napkins, however, are always good form, the latter three-quarters of a yard square, and carefully but simply folded. For round tables there are round cloths edged with heavy linen lace. The centerpiece of flowers should be arranged low, so as not to hide guests from one another; and the lighting should be softly shaded. The silver, china, and glass should be shining, and in delicate patterns and graceful shapes, even if not of an expensive quality. To the right of the plate is the dinner knife, and sometimes a second knife for separating bones from fish or for cutting a green salad, and a little fork for raw oysters. To the left the other forks are placed in the order of their use—fish, roast, salad, game, dessert. The napkin is laid on the empty plate or on the right-hand side of the knife. The soup and dessert spoons may be placed at the right of the knives, or horizontally across the table above the plate. Beyond the forks on the left is a small bread-and-butter plate, for bread, olives, etc. At the right of each place stands the water-glass or goblet.

The hostess tells each gentleman privately which lady he is to take out and sit next at the table. The host leads the way with the guest of honor for the evening, or with the oldest or most distinguished lady. The hostess brings up the rear with the chief man guest. Host and hostess face each other from the ends or the middle of the sides of the table. The guests find their places by the names on the place cards and each man draws out for her the chair of the woman sitting at his right. The men never sit down until the women are seated. All wait for the hostess before beginning to eat.

At a dinner party one should not refuse any course. If you trifle with the food and are interested in the talk, no one notices that you are not eating. You should not ask for a second helping, for this keeps everyone else waiting.

A dinner of many courses, eaten leisurely, may take two or three hours to serve. That is a visit in itself, and guests need not remain more than half an hour in the drawing-room. However, it is best to wait until the party breaks up. Thank your hostess for a pleasant evening but don't thank her for the dinner. Shake the host's hand, bow, and take your leave.

On the Street and in Public Places

RECOGNIZE acquaintances with a bow. If near enough a pleasant greeting may be exchanged. A lady bows first to a gentleman. A gentleman lifts his hat to women. He bows to his mother, wife, or sister in meeting or parting from them as ceremoniously as if they were strangers. If a gentleman wishes to talk with a lady it is better to turn and walk in her direction. And when he is walking with a lady, a gentleman lifts his hat to anyone she recognizes, whether known to him or not. The lady, however, does not recognize his friends unless they are known to her also. Remember a bow is a social civility, the smallest coin of society. It does not mean a calling acquaintance and may be given to anyone. A bow or a lifted hat should never be refused to anyone who thinks he recognizes you. He may be mistaken and if he is, he would feel humiliated by the snub.

When a gentleman is witn a lady, he takes the outside of the walk because that is the most exposed place. He does not offer his arm unless the lady is old or lame, or it is after night and she is in danger of being separated from him or jostled in a crowd. Women are not the delicate helpless creatures they were once thought to be.

A gentleman who enters a street car with a lady helps her up the steps and follows her. In leaving a car he gets off first and helps her down. He gives her the inside seat next the window and pays her fare. It used to be thought that a man or boy should give up his seat to any woman or girl who was standing. Now good manners do not absolutely require him to offer his seat to anyone who is as well able to stand as he is, but one always thinks better of a man or boy who does it. A strong person whether a man or woman, boy or girl should give up a seat to an old or ill person or cripple, of either sex, or to a woman who is carrying a child.

Never resent the behavior of an ill-bred stranger. If he wants more than half the road, give it to him. Lincoln once said: "If a man won't turn out for me, I turn out for him. This keeps the peace and expedites travel." Remember, no one can insult you. He can simply show his own bad manners. But no man or boy should stand by and see a bully abuse an animal, a child, or other defenseless person. Make him stop if you are big enough. If not, call a policeman.

The kind of behavior that is required in a well-conducted schoolroom is expected in church, theater, concert and lecture-hall, libraries, and art galleries. At any place of public worship or entertainment, it is ill-bred to arrive late, to be fussy in settling into a seat, to turn and stare about, to whisper, giggle, yawn, or flutter the leaves of a book. Such behavior is unkind to the minister or entertainer, and interferes with the pleasure of the audience. A lady should take off her hat whenever she sees that other ladies have done so. In church it is bad manners to look at a watch or to leave before the services are over. One may leave a theater or concert, quietly, between the acts or the numbers of a program—never in the middle of an act or number.

Some Points on Listening and Talking

VERY often young people complain that they do not know what to talk about in society. Talk about pleasant things. The German poet Heine once said: "God has given us speech in order that we may say pleasant things to our friends." A pleasant voice, low, clear, with an upward inflection, makes the most ordinary words sound pleasantly in the ear. Don't let your voice or your mouth sag at the corners. Look straight at the person who is talking to you. A half-open mouth, a vacant stare, a wandering eye, and restlessness, are all ill-bred. In answering, speak distinctly.

Don't say "uh-huh" in answering a question or "what!" if you failed to understand. Say: "Yes, mama," "No, Mrs. Adams." "Yes, sir," and "No, ma'am," have gone somewhat out of fashion, but they are always good manners. Nowadays we use people's names in addressing them. So if you wish to have something repeated, say: "I beg your pardon, Mr. Stuart." Use "please" and "thank you" and "pardon" freely.

Don't talk about yourself or your wonderful doings. Don't interrupt people or help anyone tell a joke. Don't get excited over an argument or be sarcastic. And don't gossip. You know what King Arthur said to his knights? "Speak no slander, no, nor listen to it." A malicious story may not be true; it is certainly unkind, and it should not interest you. Rebuke scandal by silence and by changing the subject. Talk of things and ideas, not persons, except interesting public persons like presidents, actors, authors, artists, and musicians, whose talents give wide pleasure. Be brief, be merry and bright. Draw out other people and listen. Good listeners are scarce and popular.

Cultivate some gift that will give pleasure to others and be generous with it. If asked to sing, play, tell stories, read aloud, or join in a parlor game, do so. Don't wait to be coaxed or you may be disappointed. Your refusal is ungracious and few people will urge you.

How to Make Introductions Properly

IN making an introduction the gentleman is always presented to the lady, and the younger lady to the older. It is sufficient simply to mention the two names, as "Mrs. Miller, Mr. Jones"; but it is rather more dignified to say, "Mrs. Miller, allow me to introduce (or present) Mr. Jones." The people who meet are not required to say anything—a smile and bow are sufficient, and an air of deferential attention is more eloquent than words. It is perfectly good form, however, to say, "How do you do, Mr. Jones?" or "I am happy to meet you"; and perhaps the most graceful thing to do is simply to pronounce the other's name. A flippant "how-de-do" or a "happy to meet you," said as mechanically as a talking doll would say it, do not recommend anyone to a new acquaintance. On being introduced people shake hands or not, as they choose. Two men usually do so. But if you do shake hands, do it heartily, with a firm clasp. A hard grip makes the victim wince, but a limp flabby hand is about as pleasant to hold as a fish. A lifted arm, drooped finger tips, and feeble wagging is an affected travesty that is happily going out.

To make sure that everyone is introduced to everyone else at an evening party, the host or hostess sometimes takes each guest by the arm as she arrives, leading her about the room and presenting her to everyone in turn. This is awkward and embarrassing to the guest and puts a spoke in every wheel of talk. It takes a company several minutes to recover and nobody remembers anybody's name. The custom is growing for people who meet in a house to converse freely with those nearest without previous introduction. A good hostess watches as guests form groups and talk, goes about among them and makes introductions incidentally.

At receptions, of course, where the hostess stands by the door to receive, callers are introduced to the guest of honor or the debutante as they arrive.

Good Form in Correspondence

EVERYONE has occasion to write letters and notes of business, friendship, and courtesy, and should be supplied with proper materials. Postal cards are correct for impersonal messages and business notes; linen writing pads, with envelopes to fit the folded sheets, are convenient for generous family letters; but ruled lines are barred for any purpose For social correspondence note paper, of which there are three sizes, in cream-laid or white linen bond paper, is first choice. You may have your address, initials, or monogram engraved at the top of the sheet, or embossed—raised—on a heavy quality of paper and left uncolored.

A business or other formal letter should be typewritten, if possible. But social letters and notes ought to be written by hand. The date and the writer's full address may be written in the upper right-hand corner of the first page or at the end of the letter, to the left of and below the signature. For notes it is better form to spell out in full the month and day. In writing to a stranger about your own affairs, if you want an answer, you should enclose a stamp or a stamped and self-addressed envelope. No one puts a stranger to expense in matters that do not concern him.

A business letter should be begun with the full name and address of the person written to, thus: "Mr. Lawrence Bassett, 171 La Salle Street, Chicago, Illinois," arranged compactly in three lines at the left and followed by "Dear Sir:". It is also good form to begin a business letter directly with "Dear Sir" or "Dear Madam," and then put the name and address of the person written to at the end, below and to the left of your own signature. In social letters, however, one omits entirely the address of the person written to, although if he is an entire stranger the letter may commence: "Mr. William Atkins," and on the next line, "My dear Sir:". "Dear Mrs. Owens" and "Dear Alice" are familiar and are used only in writing to friends. If Mrs. Owens is only an acquaintance, she should be addressed as "My dear Mrs. Owens." A business letter ends with "Yours very truly," "Yours respectfully," or some other courteous expression. "Very sincerely yours" is warmer but is properly used with business houses with which one has been on long and good terms, with acquaintances, and with friends. With relatives or intimate friends, one should use "Affectionately yours," "With love," or any term that correctly expresses your real feelings. The full name should be signed at the end except in intimate letters. A married woman signs her own name, thus: "Margaret Boyd Monroe." If the letter is to a stranger who does not know how to address her, she should put her married name in brackets below and to the left of her signature, thus: (Mrs. John Dixon Monroe). An unmarried woman indicates the fact by putting "Miss" in brackets before her name. Any woman, married or unmarried, is addressed as "Dear Madam" in a letter by a stranger. A letter should be begun on the first page of the sheet, and the pages should be used consecutively.

Letters of introduction and messages carried by friends should not be sealed. Seal all other letters securely, but do not use wax unless you are expert in its use. In addressing a letter put the full name on one line, the street number and the street on the line below, and the city and state on the third line. Have them all compactly arranged, on the lower half of the envelope, neither crowded nor sprawled. A letter meant for a particular person, in a business office, where it may be opened in the routine work of a clerk, should be marked "Personal" in the lower left-hand corner. Of course, no one opens anyone's private letters in a family.

Put the stamp in the upper right-hand corner, where it is the most convenient for the mail clerk to cancel. And set the stamp right side up. In England, it is thought to be an act of gross disrespect to turn the king's head upside down. We should feel the same way about Washington, Lincoln, and others whose heads appear on our stamps.

ETNA, MOUNT. Two hundred miles almost due south of Mt. Vesuvius, on the eastern coast of the island of Sicily, towers the "burning mountain" of Etna—older, much higher, and grander in its eruptions (though less frequent) than its sister. More than 80 eruptions of Etna are on record, the earliest about 479 B.C. In 1169 A.D., 15,000 inhabitants of nearby Catania were destroyed, and again in 1669 some 20,000 perished. In 1792 there was an eruption which lasted for a whole year, in which streams of molten lava 30 feet high flowed down the mountain side. Over a dozen eruptions have occurred in the past hundred years, the last being in 1911.

In spite of these terrors, villages and farmhouses nestle close on the broad expanse of Etna's flanks. The mountain rises through three zones—the cultivated region, of about 2,000 feet, where date-palms, bananas, oranges, lemons, olives, figs, and almonds are grown; the wooded region in the middle, planted with forests of chestnut, cork, beech, pine, maple, and oak; and the desert region beginning at about 6,300 feet from the base of the mountain, a dreary waste of black lava, ashes, and sand, covered through a large part of the year with snow. A famous chestnut tree, one of the largest and oldest trees in the world, formed by seven trees grown together and 163 feet in circumference, is in the wooded region of the slope. A volcanic observatory 9,075 feet above the sea was built in 1880, and is the highest inhabited house in Europe, being 1,000 feet higher than the shelter on the Great St. Bernard in the Alps.

The summit of Mt. Etna is about 10,750 feet above the sea, while its base is 90 miles in circumference. A great part of the world's supply of sulphur is supplied by the craters of this mountain, which the Sicilians call "Mongibello," a corruption of the Saracen *Jebel Uttamat*, "mountain of fire."

ETRUS'CANS. Long before the days of Rome's greatness, there dwelt in that sunny land of Italy a people far advanced in civilization and culture—the Etruscans, or Tyrrhenians as they were called by the Greeks. The "riddle race" of Italy, they rose to prosperity and power, and then vanished completely from the stage of history, leaving unsolved many problems concerning their origin and civilization.

The Etruscans taught Rome much of her art and science, they gave her many of her social, religious, and political customs and institutions. Their blood mingled with that of the warlike Romans and still flows in the veins of the Italians of today. But their history is like a book that has been written and erased. Their literature has practically disappeared; the language of their inscriptions has been only partially deciphered; and only in the few remains of their ancient buildings and monuments,—most of all in their tombs,—can we read their puzzling but fascinating story.

As we see them in the paintings on the walls of their tombs, the Etruscans were a short thickset people, fond of rich garments of graceful lines and bright colors. Their religion was somber and mysterious, and they dwelt much on the life after death; but they were fond of good living, games and amusements, dancing, music, and the theater. The women were noted for their rich jewelry; golden wreaths and coronets, brooches of delicate filigree work, long earrings, massive necklaces and bracelets, rings of beautiful design and many other articles of adornment, together with mirrors of polished bronze, have been found in their tombs.

Weapons and other implements, beautiful vases, and statues of stone, bronze, and terra cotta show that the Etruscans were skilled artisans. But they had little originality, most of their work being imitated from that of the Greeks.

It is thought that the Etruscans were a seafaring people from somewhere in or near Asia Minor. As early as 1000 B.C. we find them settled in Italy, between the Arno and the Tiber, in the district which corresponds roughly to modern Tuscany. At one time their rule embraced the greater part of Italy, including Rome. When the Tarquins were expelled from Rome, about 500 B.C., Lars Porsena of Clusium sought in vain to reëstablish Etruscans.

THE GIANT TREE THAT GROWS FROM THE PIGMY SEED

Of course all seeds are small in proportion to the things into which they grow, but the seeds of the giant Eucalyptus tree are very, very small. Inside one of those little balls in the picture on the left are a large number of these little seeds, each one capable of growing into a tree taller than a skyscraper! The Eucalyptus tree at the right is of the kind known as the "Red Gum."

Driven from Rome, the Etruscans sought power in other fields. They already controlled the commerce of the Tyrrhenian Sea on their western border, and now they strengthened their naval power by means of an alliance with Carthage against Greece. But in 474 B.C. their fleet was destroyed by the Syracusans, and from then on their power rapidly declined. The Gauls overran their country, and their strong southern fortress of Veii fell to Rome after a ten years' siege (396 B.C.).

EUCALYP'TUS. The tallest tree in the world, according to some authorities, is the *Eucalyptus amagdalina*, a member of this great and valuable group of gum trees, native to Australia; and the specimen which holds the record was found prostrate in the colony of Victoria and measured 470 feet in length. The tall white stems of these trees, smooth as marble columns, frequently rise 60 or 70 feet from the ground without a branch. From such giants down to the small eucalyptus bushes so common in California, the members of this group, which embraces more than 150 species, are among the most beautiful, interesting, and useful trees known to us.

The wood is very tough and durable, and is much used for ship- and wharf-building because it resists decay in the water. It takes a high polish and so is valuable for interior finishing. Certain eucalyptus trees yield a gummy sap, from which tannin is obtained. The inner bark of some species consists of very tough long fiber, used for rope-making, paper, and thatch. The leaves, which in many species turn edgewise to the sun, furnish the eucalyptus oil (eucalyptol) used in medicine for its germ-killing and stimulating properties.

The name eucalyptus comes from two Greek words meaning "well covered," referring to the abundant foliage. Because this enormous leaf area enables them to evaporate into the atmosphere the vast quantities of water absorbed by their roots, eucalyptus trees are often planted in swamps, which they help to drain. It is this faculty for drying up mosquito marshes, rather than their pungent odor, which has won for them their reputation as safeguards against malarial mosquitoes.

The eucalyptus genus belongs to the family of myrtles. Among the most common species of the eucalyptus are the blue gum, valuable for its timber; the manna gum, valued for the nectar of its white blossoms, of which bees are very fond; the jarrah tree, most used for wharfs and docks; and the swamp mahogany, the best reclaimer of swampy lands. In the warmer parts of the United States, especially in California, a great eucalyptus lumber industry has been developed from trees originally imported from Australia whose product is known in California and the southern states as southern gum-wood.

EUGEN'ICS. Two thousand years ago Plato asked: "If care was not taken in the breeding, would not your dogs and birds greatly deteriorate? And what if the same principle holds of the human species?" Today we are asking the same question.

Eugenics as a science dates from the last quarter of the 19th century, when the term was coined by Sir Francis Galton in his book, 'Inquiries into Human Faculties'. He defined the science as "the study of the agencies under social control that may improve or impair the racial qualities of future generations, either physically or mentally." Practically, this simply means control of the unfit—the feeble-minded, diseased, and criminal—most of whose children sooner or later become wards of the state. Segregation of the feeble-minded and those otherwise physically unfit is much advocated, and is an increasingly popular method of dealing with the problem. (*See* Heredity.)

EUPHRATES (*ū-frā'tēz*) **RIVER.** Next to the Nile the Euphrates, which is the largest river of western Asia, is probably the best-known stream in history. It rises in the heart of Armenia and flows south, breaking through the Taurus Mountains in a succession of rapids and cataracts for about 40 miles. At Korna the Tigris joins it, and with the new name of Shatt-el-Arab it empties itself by several arms into the Persian Gulf, 1,800 miles from its source.

It is navigable for small boats nearly 1,200 miles and steamboats ascend it for 100 miles to the junction with the Tigris.

In ancient times, by a system of canals and embankments, the river was used for irrigating the country as the Nile is in Egypt, but the works were not kept up. Today there is little to suggest the fertility and culture of 5,000 years ago (*see* Mesopotamia). The Euphrates is mentioned in the Bible as one of the four rivers of the Garden of Eden. It is called the "great river." The city of Babylon was situated on its banks, and Nebuchadnezzar had locks and dikes made to enable large vessels to ascend it as far as the city.

The MOTHER LAND *of the* MODERN WORLD

Extent.—North to south, 2,400 miles, east to west, 3,000 miles; area, about 3,900,000 square miles. Population, about 470,000,000.

Mountains.—Northern system, including mountains of Scotland and Scandinavia (highest point 8,540 feet); southern system, including Pyrenees, Alps, and Carpathians, with Apennines and Balkans as offshoots (highest point, Mt. Blanc, 15,782 feet). The Ural Mountains (highest, about 5,540 feet) and Caucasus Mountains (Mt. Elbruz, highest peak in Europe, 18,525 feet) separate Europe from Asia.

Rivers and Lakes.—Chief rivers: Rhine, Elbe, Oder, Vistula, Dvina, and Pechora flowing northward into the North Sea, Baltic or Arctic Ocean; Rhone, Po, Danube, Dniester, Dnieper, and Don flowing south into the Mediterranean, Adriatic, or Black Seas; Volga and Ural flowing south into the land-locked Caspian Sea. Largest lakes: Ladoga (about as large as Lake Ontario), Onega, and Peipus in Russia, with numerous smaller lakes in Sweden, Finland, and the Alpine region.

EUROPE. The continent of Europe looks as though it had fallen into the Atlantic Ocean in a mad scramble to escape from Asia by the back door, and was threshing about with as many arms and legs as a centipede. Russia thrusts itself northward and is doubled back by the Arctic to form Sweden and Norway. Denmark almost breaks away from Germany. Holland (the Kingdom of the Netherlands) fairly plunges under the ocean. France and Spain shoot out southward and westward, stopping at Gibraltar just nine miles short of running head-on into Africa. Italy has kicked itself almost free and is ready to step out on Sicily. Greece and the whole Balkan peninsula are only stopped by narrow waters from blindly rushing again into the arms of Asia. The British Isles alone have made good their escape and put the Channel and the North Sea between them and recapture.

Everywhere the ocean waters run in and fill the lowlands with bays and gulfs and inland seas. Ranges of mountains stand out like knotted muscles on this struggling land-mass. The confused tongues of 60 different languages proclaim the same truth as the map—that Europe is a continent of physical or racial diversity. It is the continent of contrasts and conflicts, of glorious variety, and of life-giving progress. "Better fifty years of Europe than a cycle of Cathay," for Europe is truly the center of the modern world. Packed into Europe's small compass are more great nations than you will find in all the rest of the world put together. By a series of railway or steamboat journeys, each only a few hours long, you may hear a different language every day for several weeks. You can see the cities and the battle-fields where most of the history of the world has been made for the past 2,000 years.

Nor is any region of the world more delightful to the traveler. How rapidly the scene changes from the woods and parks of England to the carefully cultivated valleys of France; from the mountain pastures of Switzerland knee deep in flowers to the olive groves and vineyards of Spain and Italy; and from the canals and windmills of Holland to the the deeply cleft fiords of the coast of Norway! And though even the loveliest of Europe's landscapes may be no more beautiful than the lakes and mountains of North America, you get a sense of the mellowing effect of long human habitation such as we rarely feel in the New World.

How Europe is Warmed by the Ocean Winds

Europe has been the favored continent of civilization. It has no such formidable barriers of desert and mountain as Asia, no such vast distances, no such extremes of temperature. It lies entirely outside the tropical zone and almost entirely outside the frigid zone. Its average elevation above the sea is the lowest next to that of Australia. These two advantages, combined with the warm winds blowing from the Atlantic, give it the mildest and most genial climate of all land masses in the same latitude, as well as a wide distribution of rainfall.

Half the secret of the livable quality of this continent lies in its seacoast—20,000 miles of it if you take only the important indentations, and 50,000 or 60,000 or even more if you count every little bay and inlet—about one mile of coast for every 75 square miles of area. Besides being a long coast it is a western coast. What that means to the climate you will know if you have ever had occasion to compare a bleak Maine winter with the mild winter of the state of Washington, which lies even farther north. You will realize that the warm west winds from the ocean make the western edge of a large land body much warmer than the eastern, and so you will not be surprised to learn that balmy Venice is slightly farther north than the forbidding harbor of Vladivostok in Eastern Siberia.

Steam heat would probably never have been invented if America had the climate of the Channel Islands, which lie between France and England. There you are never hot, never cold, and the fire that you light in the grate of an evening is often just for the sake of cheerfulness. To a certain extent this equable climate is found in the larger British Isles as well, though they lie so far north that in summer it is still daylight at nine o'clock, with an afterglow to follow, and in winter the day is correspondingly brief. A delightful and still milder climate characterizes the Mediterranean islands—the Balearic group, Sardinia, Corsica, Sicily, Crete, Cyprus, and the Grecian archipelago in the Aegean.

A Peninsula of Peninsulas

In large measure the oceanic climate of the islands extends to the mainland as well. Europe has been called a peninsula of peninsulas, and nowhere else are such peninsular formations to be found—letting the sea and its equalizing winds far into the land.

If you should take ship as far to the southeast as possible, you would come first to the little peninsula of the Crimea reaching down into the Black Sea. Then sailing through the Bosporus at Constantinople, the Sea of Marmora, and the Dardanelles, you would travel far to the south to skirt the Balkan Peninsula, which is tipped by Greece. Continuing westward you would come to Italy, which is like a long pierhead of Europe almost joining the snowy Alps to the sandy Sahara. Then sailing the last half of the length of the blue Mediterranean, you would come to the Iberian Peninsula, which includes Spain and Portugal. This is the second largest of all the peninsulas of Europe. It is so broad and high that, except for the low-lying rim, it has a continental rather than an oceanic climate. Continue through the Strait of Gibraltar, around Portugal, across the Bay of Biscay, through the English Channel, and into the North Sea, and presently you will come to the peninsula of Denmark jutting north from Germany. Just opposite is the Scandinavian Peninsula, the largest of all, shaped something like one of the warm woolen mittens you would need to wear there in winter.

The long deeply indented seacoast means commerce as well as a temperate climate. At first you will be surprised to find that most of the important seaports on the Atlantic lie well inland. Hamburg is 75 miles up the Elbe, and Bremen is about 50 miles up the Weser. Amsterdam lies at the end of a sea canal, Rotterdam some distance up the Rhine, and Antwerp at the head of the estuary of the Scheldt. Hull is on the Humber, and London on the Thames. Havre and Rouen are up the Seine, Nantes up the Loire, Bordeaux on the Garonne, Oporto up the Douro, Lisbon up the Tagus, and Seville is no less than 70 miles inland on the Guadalquivir. But, you might ask, don't the great ocean liners and freighters have a hard pull to work their way so far inland? They would but for the fact that these rivers all have wide tidal mouths or *estuaries*, and that twice a day the strong tides of the Atlantic increase the depth of their waters.

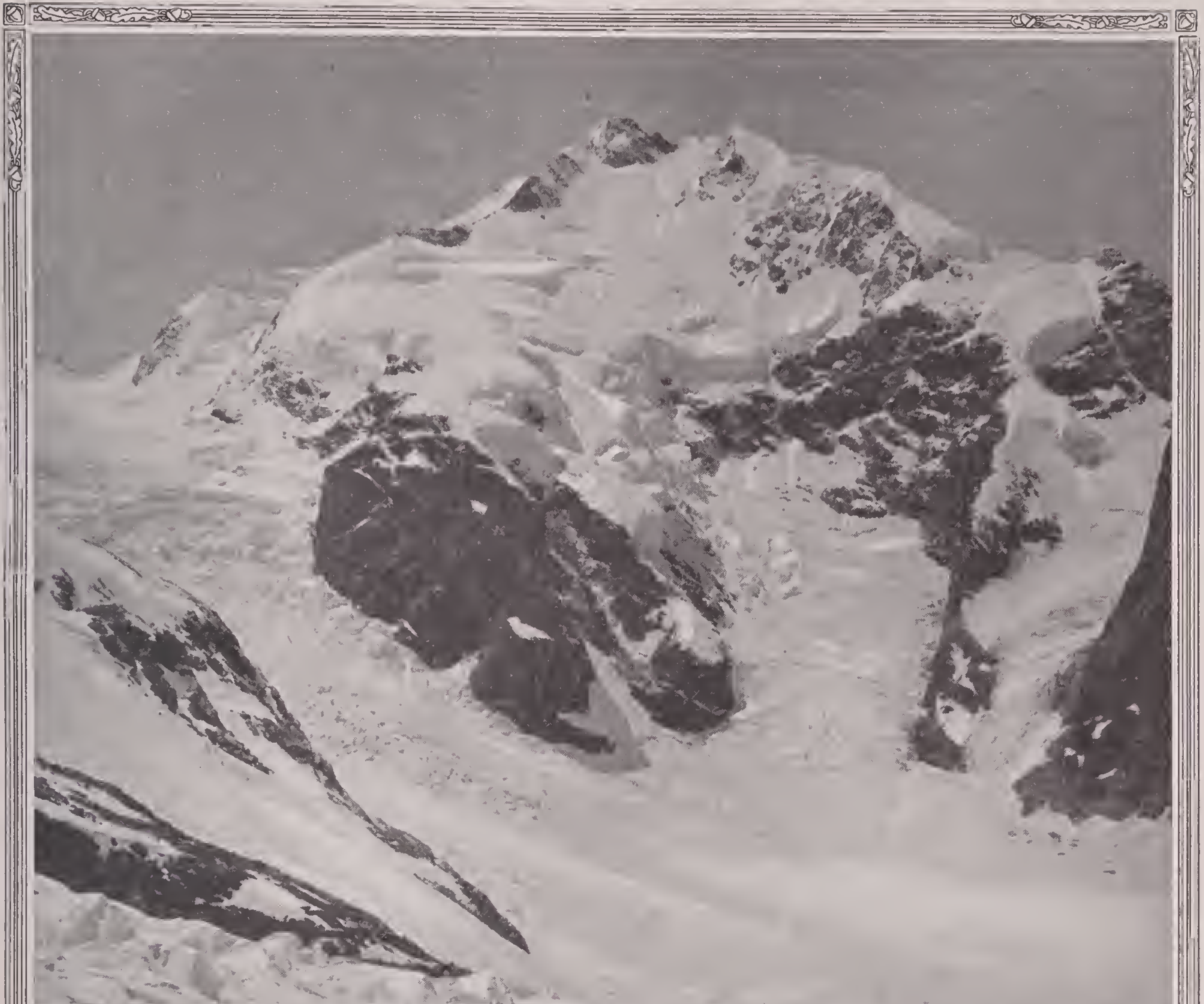
How the Mediterranean Lacks Rivers

The Mediterranean, unlike the Atlantic, commands no great navigable rivers. You will notice that the Ebro, the Rhone, and the Po are the only large rivers flowing into it or any of its arms. Of these the Rhone is too swift, and the others are at certain seasons too shallow for sea-going vessels. Nor would the Mediterranean river ports—if there were any—have the advantage of tides enjoyed by the Atlantic ports, for although there is a three-foot rise and fall at Venice, the Mediterranean tides are in general slight.

The ports of the Black Sea are of comparatively little importance, although into it flow four great navigable rivers—the Don, the Dnieper, the Dniester, and the Danube. The Danube is the second river of Europe and forms the great highway between Central Europe and the East. The Caspian receives the largest river of Europe, the Volga, which is navigable for 2,260 miles out of its 2,325, but is icebound for 100 to 150 days out of the year. This fact, together with the accident of its emptying into the landlocked Caspian, makes it chiefly important for local traffic along its course. The same is true of the northern rivers, the Pechora flowing into the Arctic, and the Dvina into the White Sea. These are icebound more than half the year, and only during the summer months can timbers, furs, and grains be brought to Archangel for export.

Europe's long seacoast creates industries of its own as well as fostering commerce. Fleets of fishing boats

A GEM IN EUROPE'S MOUNTAIN CROWN



This mighty peak in the Alps is known as Piz Bernina, and is 13,295 feet above sea level. It rears its snow-capped summit in southeastern Switzerland, near the Italian border, and looks northward across the famous Upper Engadine Valley. Those men in the picture must be hardy climbers, for the ascent is one of the most difficult in this whole region. Quite aside from their beauty, the Alps are of great importance to Europe. Their snows feed great rivers that water the fertile fields of France, Germany, Austria, and Italy, and they supply cool breezes for the surrounding plains.

dot nearly its entire length, and push boldly out far into the open sea—to Arctic Iceland and the distant Banks of Newfoundland. In the Baltic and North seas the fisheries are practically inexhaustible, for the numerous rivers contribute mud and loam rich in fish food. Near the fishing grounds the curing of fish is an important industry. Olive oil and sheet tin for putting up sardines are among the largest imports of Norway, and smoked, salted, or pickled cod, salmon, and herring are also produced in large quantities. "Kippers" and Yarmouth "bloaters" (forms of herring) from Great Britain, and anchovies and sardines from the Mediterranean and the Atlantic coast of Spain and Portugal go all over the world.

How would the continent of Europe look if we could view it from high in the air and see its whole extent as a great panorama stretched out before our eyes? Imagine that we are soaring far above the Alps—the roof of Europe—in a captive balloon equipped with instruments powerful enough to bring any part of the continent we want beneath our gaze.

First look straight down. Under our feet lie the snow-capped peaks of the Alps, rising from valleys dotted with lakes and the rainy green of mountain meadows. This magnificent mountain range, from 10,000 to 15,000 feet high, is one of the many ranges of young rugged mountains of southern Europe.

As we turn our eyes to the south, we see the Alps falling steeply to the low fertile Po River basin, the plain of Lombardy. This is perhaps the most productive region of Europe; its meadows may be mowed six times in the year. On both sides of the Po valley the Alps thrust out long fingers to the southeast—young jagged ranges, but not so high as the central mountains. One of these, the Apennines, forms the backbone of Italy, reaching far into the Mediterranean and nearly joining Europe and Africa by way of the island of Sicily. On the eastern side of the Adriatic Sea we observe the Dinaric Alps, continued by the huge broken sprawling mass of highlands which make up the Balkan Peninsula, with the Balkan Mountains pushing eastward to the Black Sea, and the Pindus Range forming Greece.

ALONG THE BEAUTIFUL AVON

Without a doubt, young William Shakespeare fed the swans on the Avon, just as this man is doing here. The spire you see is that of the Church of the Holy Trinity at Stratford, which stands on the site of an ancient Saxon monastery.

Swing your gaze slowly eastward. Notice how the lines of the eastern wing of the Alps are prolonged northeastward across the Danube by the grand sweeping curve of the Transylvanian Alps and the Carpathians, which circle around the plain of Hungary. In this mountain-girdled basin great waving fields of wheat, corn, flax, and rye interchange with treeless steppes, where millions of horses, sheep, and cattle are grazing. The lower basin of the Danube, separated from the Hungarian plain by the gorge of the Iron Gate, where the Balkan and Carpathian ranges almost meet, is a far-stretching expanse of treeless plain. There the Rumanians raise their wheat and corn and pasture extensive herds.

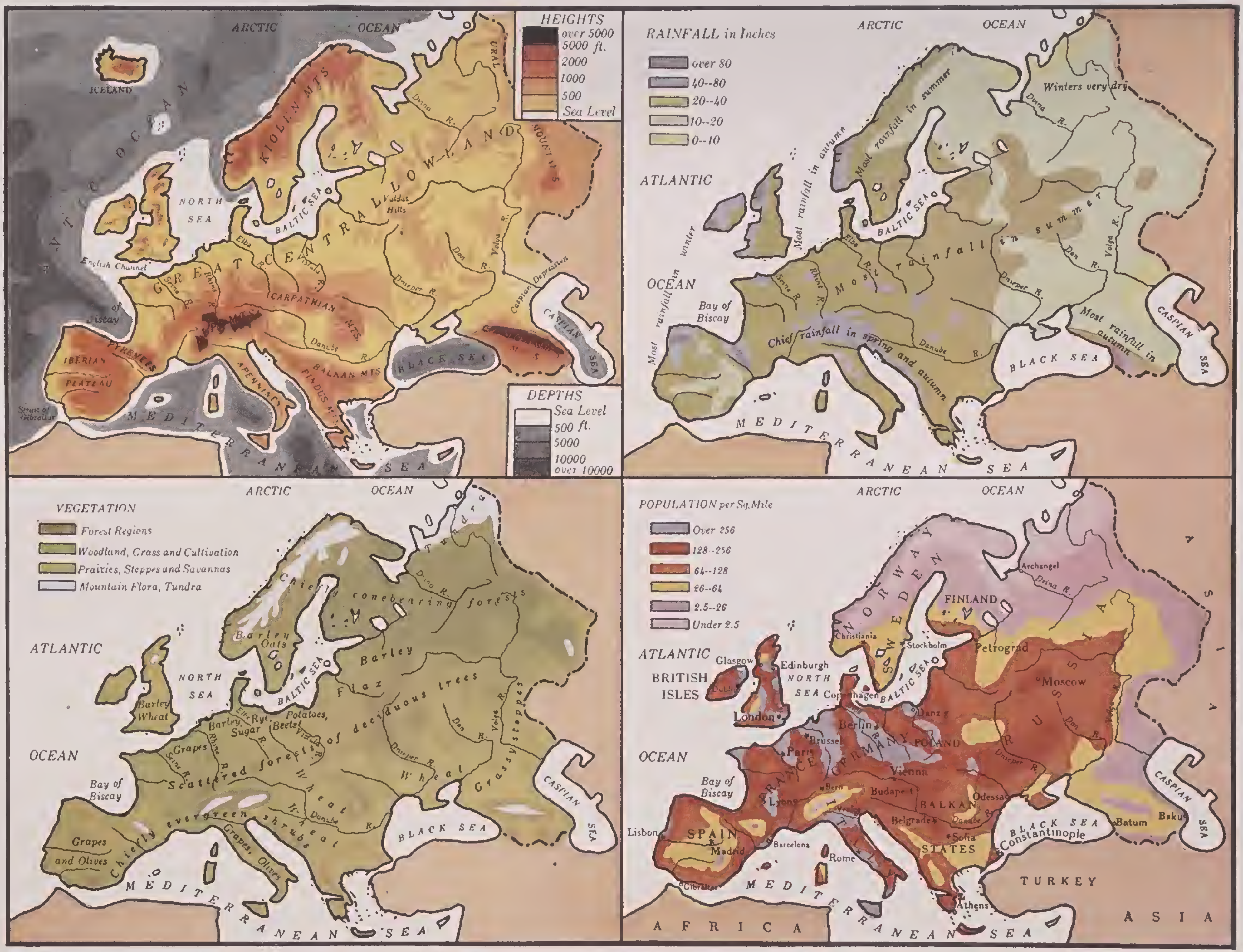
Look still farther, across the Black Sea, until your eye is caught by the enormous frowning mass of the Caucasus Mountains, rising like a wall across the neck of land that separates the Black and Caspian seas. This is Europe's southeastern frontier, a natural rampart towering 3,000 feet higher than the Alps.

Now let your gaze travel toward the north. In the far distance—2,000 miles from where your balloon soars—you dimly see the long low range of the Urals, which forms 1,200 miles of the boundary between Europe and Asia. These are old worn-down hills, the mere stumps of mountains that once rose steep and high, reaching from the Arctic Ocean almost to the Caspian.

Cast your eye over the vast Russian plain between the Carpathians and the Urals. What a prodigious expanse of monotony! Nearly the whole of it is covered with enormous grasslands and fields of wheat and other grains, potatoes, and sugar-beets, alternating with woods and marshes.

In the far south, near the Black Sea and the Caspian, the plain becomes a treeless steppe, covered with tall grasses which conceal the pasturing herds of the nomadic inhabitants. Around the margin of the

THINGS YOU SHOULD KNOW ABOUT EUROPE



The well-scattered mountain systems of Europe give it a fairly even distribution of rainfall, which in turn largely accounts for the plentiful vegetation, the concentration of peoples, and the high civilization.

LITTLE HOLLAND AND THE MIGHTY SEA

After a summer vacation in Holland, among the principal things you would carry away in your memory would be those which the artist has brought together in this picture: The coast line with its dikes designed to keep back the sea and to furnish walls for the canals, which are so vital a part of Holland's transportation system; the roadways with their bordering trees like those in the upper left distance; marshy lands partly flooded (shown to the right) with a large canal or river in the center crowded with big and little boats. Just this side of the marshy land is a "polder," a morass which has been drained and is now cultivated. Notice the roadways on the top of the dikes, the villages below water level, the windmills, and the cattle in the rich green pasture lands.

Caspian, in the basin which that sea once occupied, the soil is so filled with salt left by the retiring waters that few plants will grow.

In the far north, next the icy Arctic Ocean, the plain takes the form of the moss-covered swamps called "tundras," which never thaw for more than a yard's depth. Here grow only mosses, lichens, dwarfed trees —many only a few inches high—and a few hardy plants which greet the midnight sun of the brief summer with the gaudiest of flowers.

From our gently swinging balloon we let our gaze travel on, following the line of the Arctic Ocean to the west. Plains, nothing but plains, until we spy the forest-covered hills of Finland between the Arctic Ocean and the Baltic Sea, with its girdle of cliffs rising steeply from the sea. Its granite floor of old worn-down hills, something like New England, is worn into thousands of angular lake basins, which cover its surface in a network.

Looking still farther west, we observe that the upland of Finland rises into the broad highland mass of the Scandinavian peninsula, which reaches south between the Gulf of Bothnia and the Atlantic. The mountains of Sweden and Norway have been worn down by the ages into a series of broad plateaus dotted with clear blue glacial lakes. Their base too has sunk deeper into the ocean, allowing the sea to enter the valleys and making the steep-walled fiords which everywhere cut the Atlantic coast of Norway.

Follow the line of the Scandinavian peninsula southwestward to the British Isles, across the North Sea. If we could look down through the waters to the ocean bottom, we should see that the North Sea is far shallower than the rest of the Atlantic. In fact the North Sea is a drowned plain which once rose above the surface of the ocean and joined the British Isles with continental Europe. This whole region has now sunk so far beneath the waves that only the high plateaus and tops of the mountains still remain uncovered, forming the British Isles.

Swing your eyes back to the great plain—the "bread-basket" of Europe. Notice how it continues westward along the Baltic forming the fertile lowlands of the new Baltic states of Esthonia, Latvia, Lithuania, and Poland. Farther on it forms the northern half of Germany, with the little Danish peninsula jutting north as if to meet the Scandinavian. As it swings to the south along the North Sea, it narrows down, forming Holland and the lowlands of Belgium—much of it so low that it is actually

SUMMER SUNSHINE ON THE BAY OF BISCAY

These are the children of wealthy Spaniards in charge of the maids on one of the promenades at San Sebastian, on the Bay of Biscay. San Sebastian is the summer residence of the Spanish court, and both because of its own attractions and the presence of royalty has thousands of visitors during the summer who come for the numerous festivities, the bull-fights, and the bathing.

below sea-level and is only prevented from being drowned like the rest of the old North Sea plain by a great system of dykes. In northwestern France the plain enlarges, forming the fertile Paris basin. On it goes, past the plateau of Brittany—once a part of the chain of mountains that ran all the way in a great semicircle through the British Isles to Scandinavia—again expanding to form the great wine and wheat district of the Garonne River valley.

Here our gaze is stopped by the formidable barrier of the Pyrenees, the young and rugged range which completely shuts off the Spanish peninsula from the rest of Europe, except around its flanks. On the other side of the Pyrenees we see the dry barren plateaus of Spain, traversed by chains of mountains and bordered by narrow strips of lowlands along the coast.

We have now swung around the whole of the continent of Europe and noted its most important natural features, except for the central highlands that slope north and west from the Alps to merge into the long coastal plain. Now look westward, across the Rhone. Notice the worn-down ranges of the Cevennes, continued to the north by the forest-clad Jura Mountains and the Vosges. Beyond and almost below us, bordering the Rhine Valley, rise the Black Forest and the other ranges of hills, mountains, and plateaus that make up central Germany and western Czecho-Slovakia. These central highlands are the treasure house of Europe. They contain the great iron and coal mines on which the industrial prosperity of Europe depends; and they are rich in many other kinds of minerals, as well as water power and timber.

No United States of Europe

Now how is it that we do not have a United States of Europe as we have a United States of America? Europe is so small, so compact, so united by its excellent seacoast without and by its many navigable rivers within, that we might expect to find it the seat of a single government. Why must you know 50 or 60 languages to converse with the natives of all the various parts of Europe, while one will suffice for almost the whole of the much larger continent of North America? Why should some of the Swiss cantons speak German, others French, and yet others Italian? Why should there be two different nations speaking different (though somewhat similar) languages in the Scandinavian Peninsula, and again in the Iberian Peninsula? Why in the small compass of the British Isles should there be four distinct national areas, England, Scotland, Wales, and Ireland? Why should Holland and Denmark—which would both go into Ireland and leave some to spare—have each its own language? Why should not the tiny states of the Balkan Peninsula, with their common interests, have clubbed together to form a single government for the region?

That part of the secret of Europe does not lie in the coast line, but in the internal formation—the multiplicity of short mountain ranges and little valleys. Something is due of course to the history of the settling of Europe, and something to accidents of conquest; but the main story is told in the minute diversity of surface that gives every little section its own personality.

For an example of the isolating influence of even moderately high mountains you have only to consider the mountain peoples of Kentucky and Tennessee. You will then understand how language and tradition have been preserved in the hills of Scotland and Wales, and how the mountain backbone of Scandinavia marks off the Atlantic fishing country of Norway and the Baltic country of Sweden, with its rich mines and the wider flatter surface that helps to foster farming; how mountains isolate the various parts of Spain from one another; and how every little racial group in the Balkans has preserved its own national character through the centuries. So, too, with the mountain barriers of Switzerland, which, while separating the cantons, have long been ramparts of freedom for their bold and independent peoples.

The existence in our own day of such small countries as Belgium, Holland, and Denmark is frequently explained by their convenience to the larger countries as buffer states. This does not explain their origin, however, nor why the experiment of uniting Belgium and Holland in 1815 was a complete failure. Holland is simply the delta land of rivers, and its low-lying soil growing coarse salty grasses is good only for cattle raising, the dairying industry, and a few root crops. The pyramids of cheeses—round ones painted cherry red, pineapple ones varnished yellow—combine with the canals, dykes, and windmills to give Holland an individuality quite different from that of its mining and manufacturing neighbor Belgium.

France, the Land of River Valleys

France is the land of river valleys; the Seine, the Loire, and the Garonne flowing into the Atlantic, and the swift, "arrowy" Rhone, walled in by the Cevennes Mountains, the Alps, and the Jura, into the Mediterranean. France has 5,500 miles of navigable river joined by 3,000 miles of canal. And in like manner each of the political divisions of Europe—even each little section speaking a different language—has a distinct personality based upon its geographical features, and the consequent isolation of its customs and interests from those of its neighbors.

AMONG THE FAMOUS LAKES OF NORTHERN ITALY

Among the Italian Alps, near the Swiss border, lies a group of lakes, in the midst of scenery unsurpassed anywhere in Europe for grandeur and colorful beauty. This is a view from the little town of Stresa, looking across the western arm of Lake Maggiore. The Borromean Islands, which you see, were once barren rocks. But Count Vitaliano, a wealthy 17th century nobleman, carried soil to them from the mainland, and established gardens, which now bloom with oranges, magnolias, and oleanders. His old unfinished chateau on the nearest island (called Isola Bella, "the Beautiful Island") contains today many beautiful paintings and tapestries

Although Europe is the smallest of the continents, with the exception of Australia, it is the most densely populated. Its area would go three times into Africa, and four times into the Americas or Asia. Yet it has a population of about 470,000,000—more than half as much as Asia, and more than twice that of the Americas. For every square mile of its area there are 120 people, against 50 for Asia, 16 for North America, and 8 for South America. Europe long ago reached the stage where it could not raise enough food to feed its teeming and enterprising peoples. That is the chief reason why England, France, Spain, and Portugal spread over into the Americas, and why the race for the control of Africa and Asia has produced such bitter and fateful national antagonisms. There are still so many people in Europe that few of the countries could feed or clothe themselves without imports. Especially home agriculture cannot provide for England and Belgium. These are the two most densely populated countries, because they have an abundance of coal and iron and therefore have become great workshops for the rest of the world.

Germany, a great iron producing country, the world's largest source of zinc, and the third coal-producing country, fared badly during the World War when cut off from outside supplies. France with less coal and greater iron deposits could almost feed itself, except for certain tropical necessaries such as chocolate, tea, and coffee. Russia, Hungary, and the Balkan states alone normally have food enough and to spare for their populations.

And so Europe has sent forth her peoples to all parts of the earth until the whole world is Europeanized. She buys and sells, borrows and loans, gives and receives—and yet remains populous, rich, important, ever a subject of new and deeper interest, and the center of the world's civilization.

Some Interesting Facts about Europe

On a map of the world, Europe is only a peninsula of Asia. Geographers have given the name Eurasia to the continents of Europe and Asia considered together.

Europe is the only continent which has no desert areas. Two-thirds of it consists of lowlands. Vesuvius and Etna are among the few active volcanoes of Europe.

Comparatively few wild animals still remain. Reindeer and polar bears roam parts of the far north, and a species of wild ox is occasionally found in the forests of Poland and Lithuania. Some of the wilder forest regions are infested by wild boars, bears, and wolves. The lynx is common in Sweden and Norway. The chamois, in small numbers, still wanders over the Alps, the Pyrenees, and the Carpathians. Deer and other game preserves are numerous.

Europe falls into three main climate divisions: (1) the Mediterranean region, where the summers are dry and hot and the winters mild and rainy; (2) the east, where most of the rainfall comes in the summer and where the differences between summer and winter are great; and (3) the west, where the rainfall is distributed throughout the year and the changes in temperature are slight.

Europe is the chief manufacturing center of the world. No other continent has so many people engaged in manufacture.

It contains the largest city in the world, London, and the smallest independent country, Monaco, eight square miles. (*See* Monte Carlo). There are also three other tiny independent or semi-independent countries—the republic of Andorra, 191 square miles, in a valley of the eastern Pyrenees between France and Spain; the republic of San Marino, 38 square miles, in the northeastern part of Italy; and the principality of Liechtenstein, 65 square miles, lying between Switzerland and Austria.

The railway mileage of Europe is about 215,000. The United States, with a slightly smaller area, has 265,000 miles.

A large part of Europe was once covered with forests. Ages of reckless destruction exhausted the timber over many thousands of square miles, and this so seriously affected climate and irrigation that the leading governments now replant and care for forests systematically.

The Thrilling Panorama of Europe's History

TWENTY-FIVE thousand years ago, at the close of the last "Ice Age" or glacial epoch, primitive man had already marked Europe for his own. From the caves of France, Spain, Germany, and elsewhere; over wooden villages set on piles driven into lake- or river-bottoms; from southern Sweden and Switzerland to the heel of Italy and the Black Sea—the smoke of his camp-fires floated over the forests. With inconceivable slowness and pain he rose from savagery to barbarism. More advanced civilization began, about 2,500 years B.C., to come from Egypt and Asia, by way of the islands of the Aegean Sea. In course of time this flowered into the splendors of Greek and Roman culture. With these two peoples there begins the recorded history of Europe, as opposed to our dim glimpses into its prehistoric past. (*See* Aegean Civilization; Cave Dwellers; Civilization; Ice Age; Stone Age.)

The Germans Invade the Roman Empire

On the death of Theodosius the Great (395 A.D.) the Roman Empire was divided finally into two parts—the Western Empire with Rome as its capital, and the Eastern Empire (also called Greek or Byzantine Empire), the capital of which was at Constantinople (*see* Byzantine Empire). Beyond the boundaries of the Roman world were numerous barbaric peoples, divided into three main groups: (1) remnants of the great Celtic stock in outlying parts of the British Isles; (2) Germans or Teutonic folk lying along the Rhine and Danube rivers and in the Scandinavian Peninsula; and (3) the great mass of the Slavs, ancestors of our modern Poles, Russians, Czechs, Serbians, and others, whose tribes even then lay eastward of the Teutons.

The German barbarians were divided chiefly into Goths, Burgundians, Vandals, Alemannians, Bavarians, Langobards (Lombards), Franks, Angles, Saxons, Frisians, etc. The Gothic tribes (Visigoths and Ostrogoths) for nearly 200 years had been established along the shores of the lower Danube and the Black Sea. This region was invaded by the Huns from Central Asia and its inhabitants pushed westward, causing the great Gothic invasion (375 A.D.). Gaul was overrun chiefly by Visigoths, Burgundians, and Franks; Spain by Vandals, Suevi, and Visigoths; Africa by Vandals, crossing from Spain. Italy suffered a number of invasions, especially those of the Visigoths, Ostrogoths, and Lombards; Britain, after being abandoned by its Roman garrison (410 A.D.), became a prey to Angles and Saxons sailing in their piratical vessels from their homes about the mouth of the river Elbe. But the influence of Rome—its language, law, and government—left a stamp which has never yet wholly been effaced.

It was the task of Charlemagne (768–814), building on the foundations laid by the Frankish kings who preceded him, to consolidate the Germanic conquests into an empire which stretched from the Ebro River in Spain to beyond the Elbe, and from the North Sea to a little south of Rome in Italy. The decline of classical civilization was checked; something of the Roman tradition of unity, order, and centralization was preserved in the face of advancing feudalism; and Christianity was spread through most of Western Europe (*see* Charlemagne). But Mohammedanism, established in Spain since 711, lingered in that land until the Moors were finally conquered in 1492.

Rise of Modern States

The division of the Frankish empire in the Partition of Verdun (843) became the starting point of the kingdoms and nations of France and Germany. Under Otto I, king of Germany, 936 to 973, the empire in the West was a second time revived, under the title "Holy Roman Empire." But it now included only Germany and Italy and its power grew ever less until its extinction in 1806. The Eastern Empire, in spite of many vicissitudes, fulfilled its function as a bulwark against Asiatic conquest and Mohammedanism until it was overwhelmed by the Ottoman Turks (fall of Constantinople, 1453). Where Hungary now is dwelt the Asiatic Avars, whose place was taken in the 10th century by their kindred the modern Magyars. Nothing but the little kingdom of Asturia was left of the Gothic power in Spain; but from this seed grew the Christian realms of Castile, Leon, and Aragon, which were consolidated in the 15th century into the kingdom of "their Catholic Majesties," the sovereigns of modern Spain.

The viking Northmen, after raiding from their Scandinavian homes the coasts of all western Europe in the 9th century, settled in western France in 911; then as "Normans" they founded the kingdom of Naples and Sicily in Italy, and gave a new dynasty to England (1066). Their descendant on the female side, Henry II of Anjou, was king of England, lord of Ireland, and feudal holder of Normandy, Anjou, Brittany, and Aquitaine in France. Only gradually were the Capetian kings of France able to reconstitute the unity of their kingdom and set it on that path of internal growth which made it under Louis XI, 1461 to 1483, the first strong monarchical state of modern times. Meanwhile the "States of the Church" were established in Italy as the temporal dominion of the pope; Poland and Russia became settled Christian states; the heathen Prussians were christianized and Germanized by the Order of Teutonic Knights; feudalism, Christianity, monasticism, and medieval art and learning spread everywhere, and the Crusades, the growth of town life, and reviving commerce prepared the way for that rebirth of the human spirit which we call the Renaissance (*see* Crusades; Renaissance).

Wars of Religion and Conquest

The expedition of Charles VIII of France, in 1494, to assert his claim to inherit the kingdom of Naples and Sicily started a series of wars over Italy which embroiled France and Spain for half a century and enabled the Reformation started by Luther to get such a spread that it could not be stamped out. The close of the conflict left the Emperor Charles V not only ruler of united Spain and Germany, but also of Sardinia, Sicily and Naples, Milan, the Netherlands, the county of Burgundy (Franche Comté), and a great part of the New World. His brother Ferdinand I, archduke of Austria and emperor and head of the German branch of the Hapsburgs after Charles, obtained by marriage Silesia, Bohemia, and that part of Hungary which had not fallen into the hands of the victorious Turks. The power of the Spanish Hapsburgs, under Charles' son, Philip II, and his successors, steadily declined.

The close of the Thirty Years' War (1618–1648)—the last of the wars of religion—left the Holy Roman Empire greatly weakened and practically confined to Germany and Austria. France became again the first power of Europe, having obtained much of the Burgundian lands (including Franche Comté, conquered by Louis XIV, 1643–1715). Savoy, straddling the French Alps, was becoming an Italian power. Spain still held the Spanish Netherlands (Belgium) and a great part of Italy. The Protestant Netherlands (Holland) and Switzerland had freed themselves by successful revolt from the Empire. Sweden, independent of Denmark since 1523, was one of the great powers, having conquered territories alike from Germany, Poland, and Russia. Denmark still ruled Norway. The duchy of Prussia, united to the mark of Brandenburg in 1618, was soon (1701) to give its name to a new German kingdom erected by the military power of the Hohenzollerns.

Shifting Fortunes of the Nations

In the 16th century Poland (in union with Lithuania since 1569) was one of the most powerful states of Europe, stretching from the Baltic almost to the Black Sea; but the 18th century saw its steady decline. Russia, under Peter the Great (1689–1725) and Catherine II (1766–96), became a formidable and disquieting power. Turkey, though decreased since its high-water mark of conquest in the 17th century, still retained the greater part of the former Eastern Empire. Venice held an extensive sway in the Adriatic and the Eastern Mediterranean; and Genoa held Corsica until it passed to France in 1768.

Soon after the outbreak of the French Revolution (1789) Poland ceased to exist, through partition by her greedy neighbors. Prussia had risen to the rank of a great power following the wars of Frederick the Great. Sweden had lost the leadership of Northern Europe. The Spanish Netherlands had passed to Austria in 1713, at the close of the War of the Spanish Succession; and branches of the French house of Bourbon ruled the parts of Italy that had been Spanish, as well as Spain herself. England had become the head of a British Empire, and had originated the inventions which led to the Industrial Revolution, a change quite as important in its way as the French Revolution. As "the Mother of Parliaments" she was the model to the world of constitutional government and political liberty during the first half of the 19th century.

The French Revolution and After

The wars of the French Revolution (*see* French Revolution) began a series of changes that ended in the extension of Napoleon's direct empire over Germany west of the Rhine, the Netherlands, northwestern Germany, and a great part of Italy and Dalmatia. In addition his brother Joseph was king of Spain, his brother-in-law Murat sat on the throne of Naples, and the grand duchy of Warsaw and the Confederation of the Rhine were ruled by his creatures. After the fall of Napoleon at Waterloo, the Congress of Vienna forced France to retire within her old limits, and in large part restored the old government. But Russia was allowed to annex Finland from Sweden and increase her Polish territories by absorbing the grand duchy of Warsaw. Prussia was enlarged at the expense of Saxony and by annexations on the west bank of the Rhine. Austria was given northern Italy in exchange for Belgium, which was united in unstable union with Holland until 1830. Norway was torn from Denmark and given to Sweden, with which it remained united until 1905. The states of Germany (now reduced from several hundred to 38, including Austria and Prussia) were organized into a loose union called the German Confederation, to take the place of the Holy Roman Empire which had now disappeared. A fantastic "Christian brotherhood" of sovereigns was formed by Czar Alexander I of Russia, called the "Holy Alliance." But the real power, which under the lead of the Austrian statesman Metternich, through a series of European congresses, preserved peace and bolstered up absolute power for 30 years, was the "Grand Alliance" of states which had overthrown Napoleon.

The revolutions of 1830 and 1848, whose waves spread from France over a large part of Europe, showed, however, that democracy and liberalism on the continent were not yet dead. A series of wars and diplomatic incidents covering nearly a century reduced the Turkish power to a bare foothold in Europe and freed the Christian Balkan states—Greece, Serbia, Bulgaria, and Rumania. In the second half of the 19th century the chief events were the freeing of Italy from Austrian rule and its union into a kingdom under the house of Savoy; the uniting of the German states by Bismarck into the German Empire under the hereditary rule of the king of Prussia; its annexation of Alsace-Lorraine from France after the Franco-Prussian War; and the reorganization of Austria into the Austro-Hungarian monarchy.

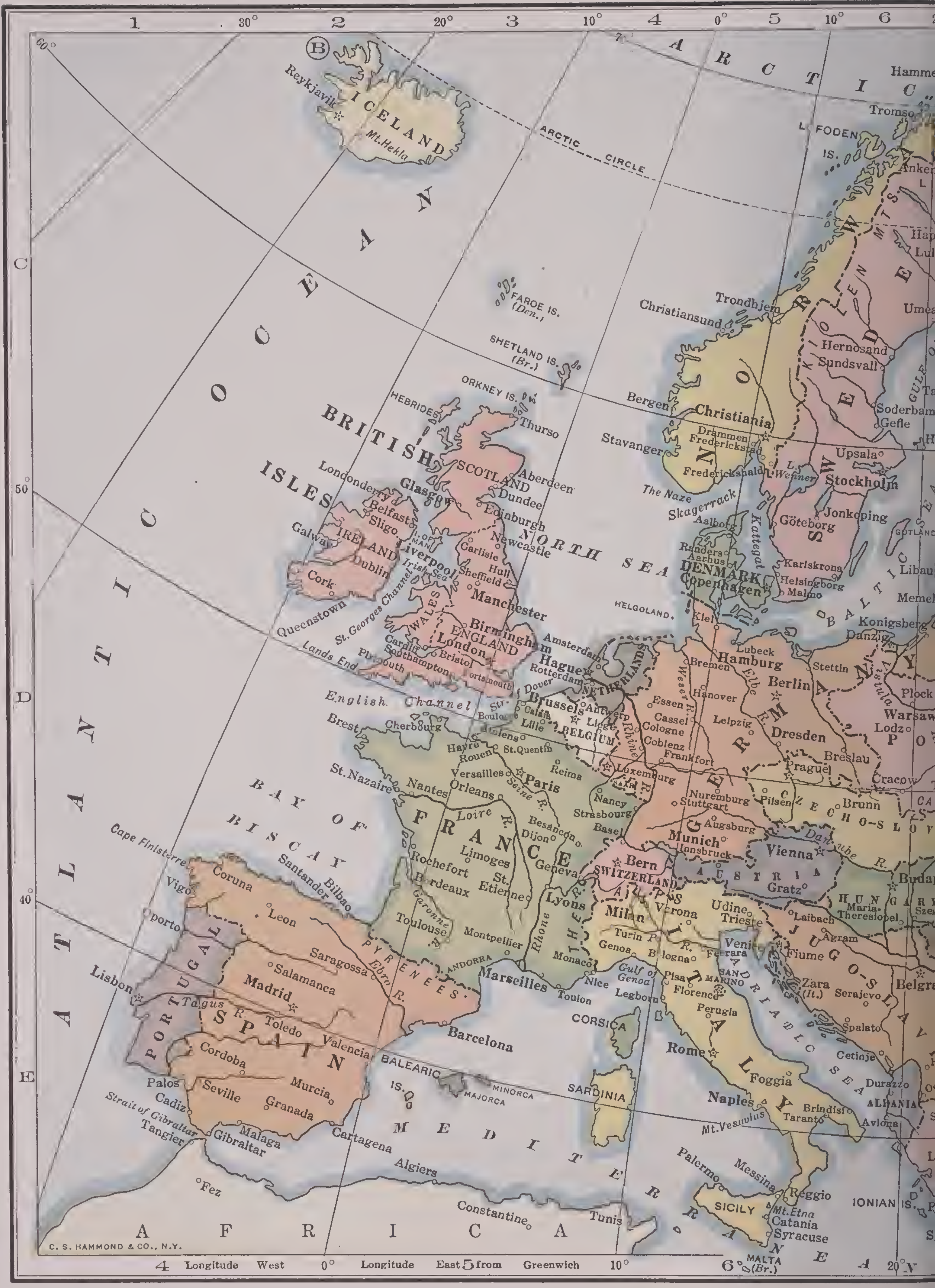
Background and Results of the World War

The events which led up to the great World War of 1914–18 cover a period of 40 years. France never ceased to resent her humiliation and losses in the War of 1870–71. The Triple Alliance, formed by Germany with Austria and Italy to preserve her conquests, was counterbalanced by the Triple Entente, composed of France, Russia, and Great Britain. Steady increases in army strength and munitions—rendered more deadly with every advance of science—made Europe an armed camp. The Hague Peace Conferences, called by Czar Nicholas II of Russia in 1899 and 1907, failed to agree to a limitation of armaments chiefly owing to Germany's opposition. In addition to having the strongest army in the world, Germany deliberately set out to challenge Great Britain's naval supremacy, on which rested the security of the British Empire and the food supply of the British Isles.

Three diplomatic crises—in 1908 over Austria's annexation of Bosnia-Herzegovina, and in 1905 and 1911 over French measures in Morocco—brought the Alliance and the Entente to the verge of blows. A war of Italy with Turkey over Tripoli in 1911, and the two Balkan wars of 1912 and 1913 (*see* Balkan Peninsula), were also accompanied by clashes of interest and ambition among the greater powers. And all the while German militarists were proclaiming the doctrine that "might makes right," demanding more colonies and a better "place in the sun," and proclaiming the superiority of German "Kultur" (civilization) and its mission to subjugate the world.

The assassination of the Austrian crown prince, Francis Ferdinand, by Serbian sympathizers in the Bosnian capital of Serajevo (June 28, 1914), was the spark which fired the magazine, and led to the world conflagration whose ultimate results will extend far beyond present times (*see* World War of 1914–18).

The immediate results of the war, as registered in the peace settlements of Versailles and other treaties, included the weakening of Germany and the strengthening of Great Britain, France, and Italy; the breakup of Austria-Hungary and the rise of the new states Czecho-Slovakia and Jugo-Slavia; the restoration of Poland with almost its former territory; the dissolution of mighty Russia in the throes of Bolshevist anarchy; the practical expulsion of Turkey from Europe and the curtailment of her territory in Asia. The map of Europe showed greater changes than in centuries. Bankruptcy lurked near at hand for practically every European state, and the interest on war debts was crushing. And throughout Eastern Europe stalked the gaunt specters of famine and disease, slaying their thousands and tens of thousands after the millions slain by the grim casualties of war.

1
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Southampton
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Plymouth
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SWITZERLAND
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Cordoba
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Seville
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Cadiz
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Strait of Gibraltar
Tangier
Gibraltar
Malaga
Cartagena
M E D I T E R R A N E A N
Mt. Vesuvius
Palermo
Messina
Algiers
Reggio
IONIAN IS.
Fez
Constantine
Tunis
SICILY
Mt. Etna
Catania
Syracuse
A F R I C A
MALTA (Br.)
ATLANTIC OCEAN
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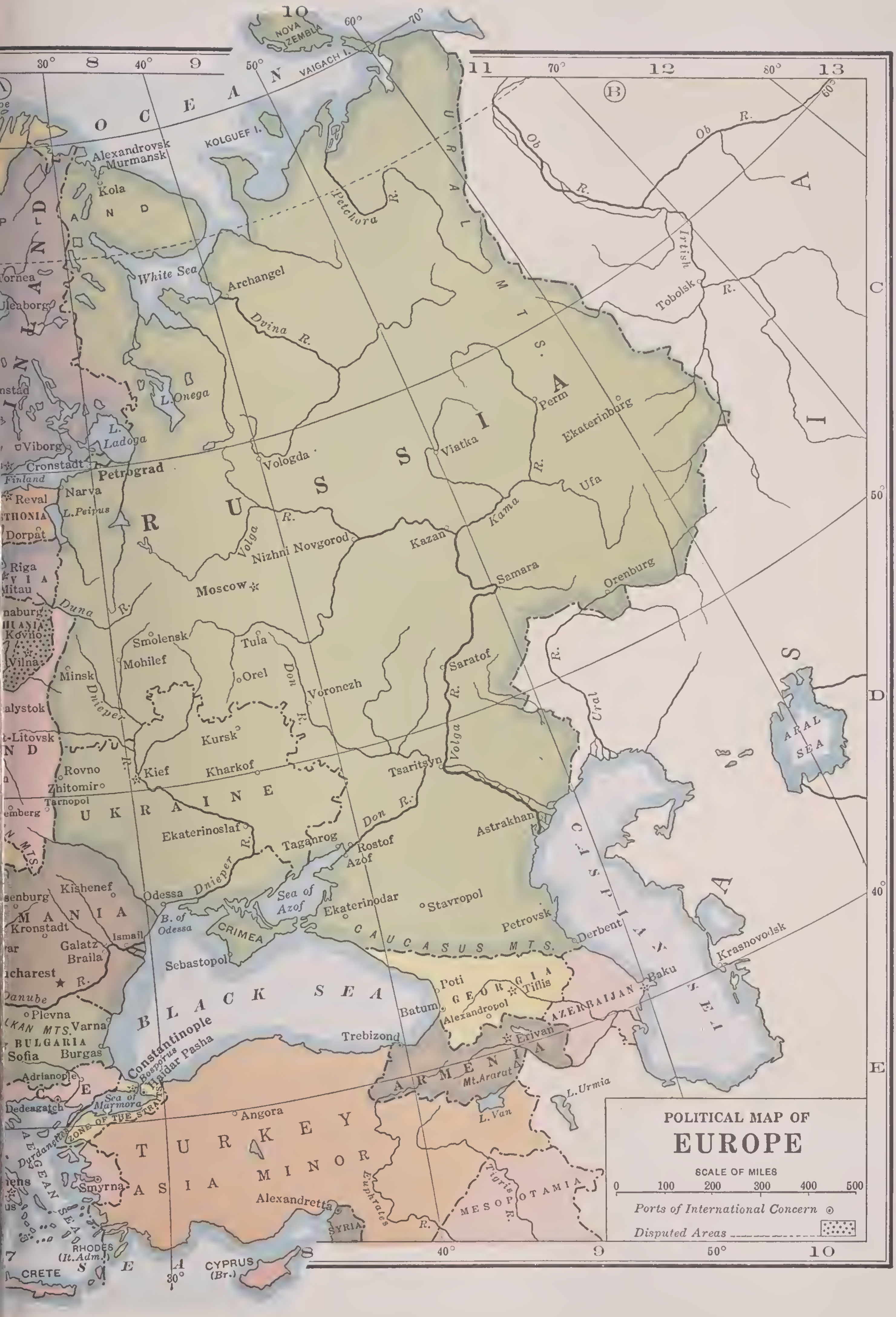


POLITICAL MAP OF
EUROPE

In MOTHER EUROPE'S TREASURE HOUSES

With all its stately palaces and picturesque canals, the pride of magnificent Venice is nevertheless the Cathedral of St. Mark, with its graceful Byzantine domes, its rich ornaments, and its wonderful mosaics. This church is a beautiful example of the art treasures that the loving care of their peoples has heaped up in the countries of Europe during past centuries.

AMERICANS who go to Europe find it like a treasure house, packed with wonderful and beautiful things. No power of words can bring into the mind the vision of the glory that men have put into this continent where our modern civilization has chiefly developed. There have always been men striving to give Europe beautiful things. There have always been men and women who have spent their lives in dreaming of beautiful things and of impressing their vision in some way on the minds of their fellows and of all who shall come after them. Never for long has the chain been broken; here and there in the darkest ages some man, faithful to mankind, was copying a precious manuscript in his monastic cell; some poor mason was chiseling a rough piece of marble until there grew out of it the face of a child; some humble artist was painting a picture on a little church wall; some builder was shaping a pinnacle for a cathedral spire; some worker in wood or iron was making a little casket that we look at with wonder even now.

Perhaps first of all the traveler will find his way to Italy; and those of us who have yet to walk through these old Italian cities, like a vast museum of all the past, have in store the greatest treat the world affords for travelers. For in Italy we walk down a street in Florence and look up at a thing that Michelangelo put there; we go through a door in Rome and see the work that Raphael did, as fresh as if he had left it yesterday; we steal quietly through the Old World streets of Pisa and climb the tower Galileo climbed when he wrote a new page in the Book of Knowledge; we meet the Emperor Augustus addressing his soldiers, clad in his suit of mail as the artist must have seen him. We see Marcus Aurelius on his horse at the top of the Capitol Hill in Rome; we touch the beautiful sarcophagus of Alexander, in which the Conqueror of the World was laid when Death had conquered him.

Amazing it is, as we go about Europe, to find ourselves in touch with wonders that stood high in the world before America had any place in history. We go down to Naples and marvel at Pompeii, looking out across the ruined streets of a city destroyed in a night, soon after Christianity came into the world. There we walk through streets the Roman nobles walked through on their holidays; we see their gardens and their fountains, sit in their rooms and in their theaters. We see the expression on a dead man's face as Death came to him in that awful night, for there the man himself is lying still, turned into solid stone, with every muscle of his face precisely as it was.

In Paris, a thousand miles or so from Pompeii, we stand beside the Venus of Milo, one of the incomparable treasures of the world, a glorious figure of womanhood, older than Christianity itself. Twenty-one centuries have passed since one of the world's great artists chiseled this noble figure in ancient Greece, and it is here today in the Louvre of Paris, a treasure house that has no rival on the earth. It would take us two hours to walk through this great place without stopping, and no two hours in any lifetime could be more filled with wonder and beauty.

Even if it were empty, this palace of art would be famous for its own sake. Some of its foundations are as old as Magna Carta; part of it was built by King Francis I, who was taken prisoner in war with Spain in 1525; and the last gallery to be finished, much nearer our own time, is not unworthy of the rest of this stately home of art. This gallery alone has 16 statues of great Frenchmen and 63 groups of allegorical statues. The gallery of Apollo, 200 feet long, is one of the finest halls in the world, paneled with priceless tapestries; it has in it all that is left of the crown jewels of France.

The Art Treasures of the Louvre

The treasure of the Louvre is beyond all calculation. There is one glorious collection worth $4,000,000 housed in a little room decorated at a cost of $50,000, and it was given to France by a great family that had its rise in Germany. There are 3,000 ancient sculptures, 2,500 pictures, and many thousands of drawings by the great artists of all nations. There are the best Raphaels in Europe, and Titians in abundance. There are six rooms full of antiquities from Assyria and Phoenicia, five rooms full of sculptures of the Middle Ages rescued from ruined churches at the time of the French Revolution, five rooms that speak to us of "the glory that was Greece and the grandeur that was Rome," two halls with relics of the Egypt of the Pharaohs, and five rooms filled with the glorious statues that French sculptors are giving to the world in our own time.

And outside, in her noble streets, Paris is a glory to see, with all her marvelous gardens, her long lines of statues, her rare and beautiful gateways, her glorious towers and domes. No traveler forgets them once he has found them, but it is strange that some of the greatest architectural glories in the world are tucked away and hard to find. One of them is the little blue chapel of Sainte-Chapelle, tucked away among the Paris Courts of Justice, where for the last 600 years it has drawn within its doors those travelers to the capital of France who seek out its quiet places. It reminds us of that other little blue chapel far away in Rome, buried underneath the streets, where lies St. Cecilia, the wife of a Roman soldier in the days when Christianity was struggling to make its way into Europe. She converted her husband and her judges, but she was murdered herself, and she has lain here in this lovely little place hidden below the streets of Rome for a thousand years and more.

The Beautiful Cathedrals

Words fail to describe the wonder of those greater buildings set up all over France—her marvelous Gothic cathedrals. How many lives of men, how much planning and toiling and self-sacrifice, have gone to the setting up of these cathedral towers and fronts which never pass from the vision of the traveler who once has seen them? These mighty monuments, almost too great for us to grasp, were built up piece by piece and carved out inch by inch; one touch and then another, till a man's life was done and another man took his place; one stone upon another till the topmost height was crowned. So year by year, generation after generation, from century to century, man laid up treasure upon earth. So arose Notre Dame in Paris; so arose the cathedral of Tours; so grew that majestic structure of Reims, now hopelessly shattered by the ravages of war; so the fair face of France was adorned with the glory of cathedrals such as that which Ruskin called "the Bible of Amiens."

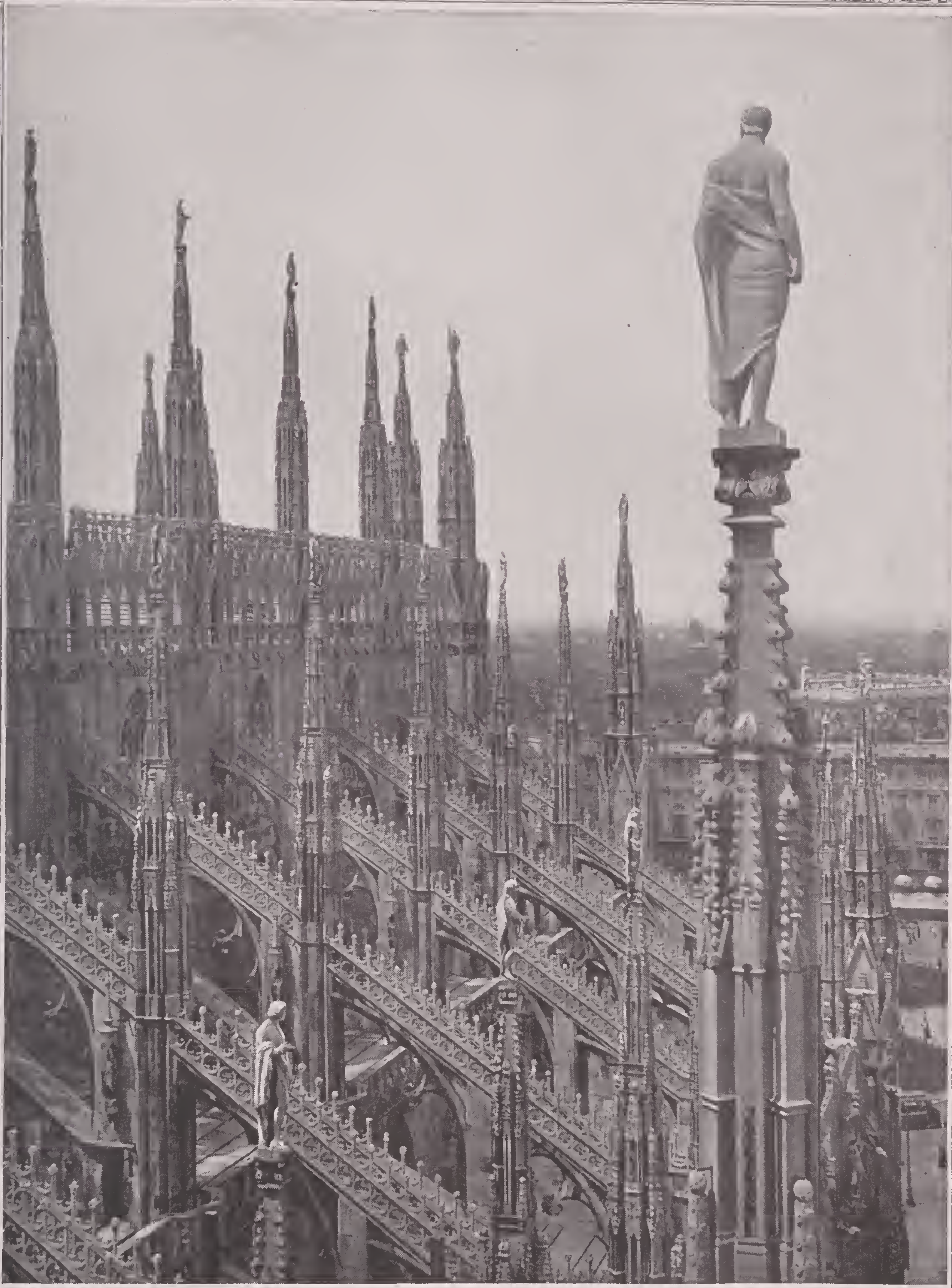
We do right to worship Nature and to love the mountain peaks, but he is less than human who can look at these monuments of men and not be thrilled with pride; he is less than human who, coming into the world for a few short years and finding these things here, can blot them out of the world as he passes through. They can never be replaced.

The treasures left behind by 60 generations of men are stored in our museums or set up in our open streets —for men have set up priceless things for the wind and rain to beat upon, trusting that the world would care for them.

Britain's Great Museum, Epitome of Civilization

It is one of the astonishing experiences of the traveler on his first visit to Europe to find himself in such a place, let us say, as the British Museum in London, a sort of kingdom of all times and all places. You think of Rome, and, lo! you pass through a high archway into the company of the Roman Emperors, all chiseled here in marble by men who knew them and saw them pass. You think of the Pharaohs of ancient Egypt, and upstairs you find them sleeping. You wonder how the first men killed wild beasts; here are the things they killed them with. You ask how the early men spent their time; here are the things they made with their hands. Here is the Magna Carta which King John was forced to grant. Here is a penny like that which was handed to Jesus when they asked if they should pay tribute to Caesar. Ask for a letter from Oliver Cromwell, and it will be given you; close by you may read one from Washington. Ask for a letter from a king of Babylon, and it is here. Here are things that filled all men with wonder when wild beasts roamed where London stands. Here is most of what is left of the Seven Wonders of the

THE CHURCH WITH NINETY-EIGHT SPIRES



Nowhere in the world is there on one building a greater wealth of spires and statuary than that which enriches Milan's late 14th century cathedral. The closer we get the more beautiful they are; for every detail, almost every stone, has been wrought with loving care into a beautiful ornament. This view shows how this ornamentation has been carried out among the "flying buttresses" which support the walls of the cathedral. There are altogether 98 of these spires on the church and more than 2,000 statues.

HOW EUROPE HOUSES HER PRECIOUS ART COLLECTIONS

Here is the famous "Hall of Augustus" in the Louvre Museum in Paris. The Louvre was formerly a palace of the kings of France, and its interior decorations reflect the elaborate richness and beauty of the Renaissance period. This room is named from the famous statue of the Roman Emperor Augustus in the niche at the far end. Most of the other statues date from the days of the Roman Empire.

ancient world—except for the Great Pyramids, that still stand in Egypt.

It is in London that we find ourselves in the presence of some of the noblest achievements of antiquity. In the British Museum we look on things that astonish us by their strength.

We find the treasures of the Bronze Age, when men first found the way to work in metal, and we see the tools and ornaments they used; we see such things as that beautiful trumpet found in Ireland, a remnant of days before there was a single page of Irish history.

We find the work of the Iron Age man. We are in the Iron Age still, for it will surely never pass, but it is thrilling to look on things that were made and used by the people Julius Caesar found in Britain.

We look on the work of men of Babylon and Assyria; we see the pictures from the walls of Egyptian houses and tombs; we catch a sense of their humor, we see in them something of the mystery and magic of the lives of men in Pharaoh's day. We can touch and handle such things as Abraham and Isaac and Jacob must have touched.

And we walk about among the art treasures of Greece, in and out among her sculptures, with all their vividness and beauty, compelling us to pause and think how great civilization was a hundred generations ago.

We come face to face with life in Rome. We see the flowing costumes of her soldiery and people; we see the games they played.

The Old World and Its Memories of the Past

Wherever we go in the Old World cities we find the memory of the past, things that have survived the wreck of time. There are places in which Time's pendulum seems hardly to have swung at all—such places as that quaint old printer's shop in Antwerp, which remains to this day as the printer left it three centuries ago; or as that merchant's house in Bergen, which is hardly altered since the merchants of the Hanseatic League conducted their business there; or as that old house in London crammed with the treasures of old Sir John Soane, all left as he bequeathed them to the world nearly a hundred years ago. Here is one most precious thing, the sarcophagus in which lay the father of that Pharaoh Rameses who filled so great a page in Egypt's history. This lovely stone coffin, by which Rameses the boy must have stood to take leave of his dead father, lies in the cellar of a house in Lincoln's Inn Fields in London, passed by thousands every day who little dream that it exists.

So it is everywhere. The streets of Paris, of Rome, of Brussels, of London, of Berlin—and Munich and Dresden and Vienna and Budapest—have in them many a touch of the human genius of the past; and if we come to some of Europe's more ancient places we find, alas, the mark of war across these ancient wonders, and glory lies in ruin. How priceless is the treasure that war in Europe has destroyed! It is to war that the world owes the destruction of one of the noblest buildings ever set up in Europe—the Parthenon which crowned the Acropolis of Athens. Here came Socrates and Plato and Aristotle; here came Demosthenes; here, to this most perfect monument of ancient art — begun four centuries before Christianity, with 100 columns, 50 life-size statues, and a frieze more than 500 feet long — came all the great Greeks whose names are written forever in the history of human thought.

ONE OF ITALY'S RICHEST GEMS

This pulpit, standing in the Cathedral at Siena, is one of two carved by Niccolo Pisano, sometimes called "the Father of the Renaissance." It was set up in 1260, at the time when Italian sculpture was just awakening from its stiff medieval forms. It is still unsurpassed in many ways for richness and beauty. The statuary and friezes represent Virtues, Apostles, and incidents of sacred story. The other Pisano pulpit is shown on page 1205.

But neither the dignity of association with these great names, nor the love of the past, nor the quality of greatness in itself, is anything to the god of war, who must be fed with human lives and the finest products of the human mind; and so the Turkish army stored its powder in the Parthenon, and an officer in the opposing army of Venetians fired a shell which broke in two the architectural pride of Athens and the crowning splendor of the most famous hill in the history of civilization. To this day the ruin stands to warn us all against the folly which destroyed it. One of the stories the traveler brings away from Rome is of the pope who tore the lead roof from the Pantheon to make into cannon-balls. It is the oldest building in the world that still stands as it stood the day the builders left it; and it dates from Augustus Caesar. But no thought of this held back the pope who wanted cannon-balls, nor even the thought that Raphael sleeps under this roof stayed his destroying hand.

Everywhere the war god is the same. A cannon-ball has fixed itself in a tree in the garden of a church in Rome, narrowly missing the destruction of a sacred casket of the 13th century; and as we go through a famous Roman palace we find a cannon-ball still imbedded in the staircase where the soldiers sent it, aimed at a spot around which are rooms crowded with precious things. It was in war that Raphael's tapestries were injured beyond repair. Made at Brussels, in wool and silk and gold, from cartoons among the most admirable of all Raphael's works, they were destined for the Sistine Chapel at Rome; but war robbed Michelangelo's chapel of this priceless glory, for the tapestries were captured and sold in Genoa, and today they have but a remnant of their original value.

What a glorious place, how far beyond the power of words to describe, is this center of the treasures of Rome, the Vatican. Here, in this unparalleled palace, where popes have lived for 1,400 years, where Charlemagne lived on his visit to Rome in the year 800, is gathered together incalculable treasure. Here, for all the ages of the world to see, Michelangelo left his noblest work; here Raphael crowded spacious walls with his immortal figures. The traveler leaves the Vatican with an overwhelming sense of glory; nowhere else in the world is brought together such a boundless wealth of astonishing things as in this building, which we think of afterwards as a sort of marble forest, so enormous are the distances under its roof. One half of one of its corridors has 700 marble sculptures; the other half has 5,000 precious inscriptions from pagan and early Christian times let into the walls. Another corridor has some of the first maps of the world built into the sides; others are packed with visible glories of the Roman Empire that are unmatched anywhere.

The length of the Vatican is given as 1,150 feet and the breadth as 167 feet; it has 8 grand staircases, 20 courts, and thousands of rooms. In one little beautiful hall in this home of the popes are 50 statues and 90 busts unequaled in interest anywhere else in the same space. They include Augustus speaking to his soldiers; Titus, the conqueror of Jerusalem, and his daughter; Diana beholding the sleeping Endymion; Demosthenes with a scroll in his hand, as Athens knew him so well; a group of 16 playing children; a mosaic with Diana of the Ephesians; Hadrian, the emperor who built the great Roman wall across Britain; Mark Antony, who loved Caesar; and old statues of poets, athletes, barbarian chiefs, and other figures who seem to be stepping out of the ancient world as we stand and look at them. Trajan, too, is in this precious little hall—Trajan, in whose forum there still stands the marble column with a spiral band winding around it carved with 2,500 human figures.

And there stands at the top of a staircase in Rome the beautiful tomb of St. Helena, made from one immense block of porphyry, with the triumph of Helena's son Constantine carved upon it. It has been in Rome 750 years, and lay in fragments in a cloister from 1600 to 1750. But somebody cared enough for this stately tomb to keep several men seven years in restoring it and polishing it; and it is one of a thousand impressive pieces of masonry, so beautifully carved that, though they are but tombs, they seem to be almost alive.

Our Rich Inheritance of Art

Who can travel through Europe and look on all these things of beauty and not be grateful to all these countless artists of the past, thousands of them poor and unknown men, who left us this work of their hands? Everywhere, in all the ages of the world, men have sought to leave for us something we could look at, something it would lift up our hearts to see. We think of Nicholas Poussin, the French painter of the 17th century, who could live nowhere but in Rome, and devoted his life to bringing before our eyes the great figures of classical history and Greek mythology. He would study broken statues and pore over ruins to get the secret of their beauty, and carry it on as a mother carries on the breath of life; and he would pick up a handful of earth, with fragments of lime and grains of porphyry and marble, and would hand it to a Roman friend, and bid him "Take this to your museum, and say, 'This is ancient Rome.' " So men have loved the past and saved it for us, that we might love it too.

They have built windows of transparent stone, like the stone of which Nero built a temple, which had no windows yet was light as day. They have made cathedral gates which compel all men to stop and gaze upon them as they pass, like the gates of Ghiberti, of which Michelangelo said that they were "fit to be the gates of heaven." They have translated into marble the joy and praise of the Psalms of David, as in the singing choir of Luca della Robbia (in Florence), worthy of immortality.

They have given us quiet cloisters in cities, where men can put off the stress and strain of the working day, and walk as in another world. They have built up temples and filled them with solemn splendor; have laid out gardens fit for angels' feet to walk in. We may sit for hours enthralled by the charm of some small thing; we may live for years in the cities men have made and never tire of their beauty.

A Charm that Never Grows Old

And what amazes us most of all, perhaps, is that these great beautiful things, often of astonishing strength and gigantic size, have a marvelous delicacy of touch and a wondrous charm, and seem as fresh as if they had left the sculptor's studio yesterday. Yet we know that all these things are ages old, and there comes to us, as we look at them, a sense of the continuity of the world.

One generation goes and another comes, and the work of each lives on. One man thinks a beautiful thing, and in ages to come other men read and other men look, so that, long after the thinker and the artist have passed beyond the memory of the world, the things they said and the things they made move the hearts and help to shape the minds of men.

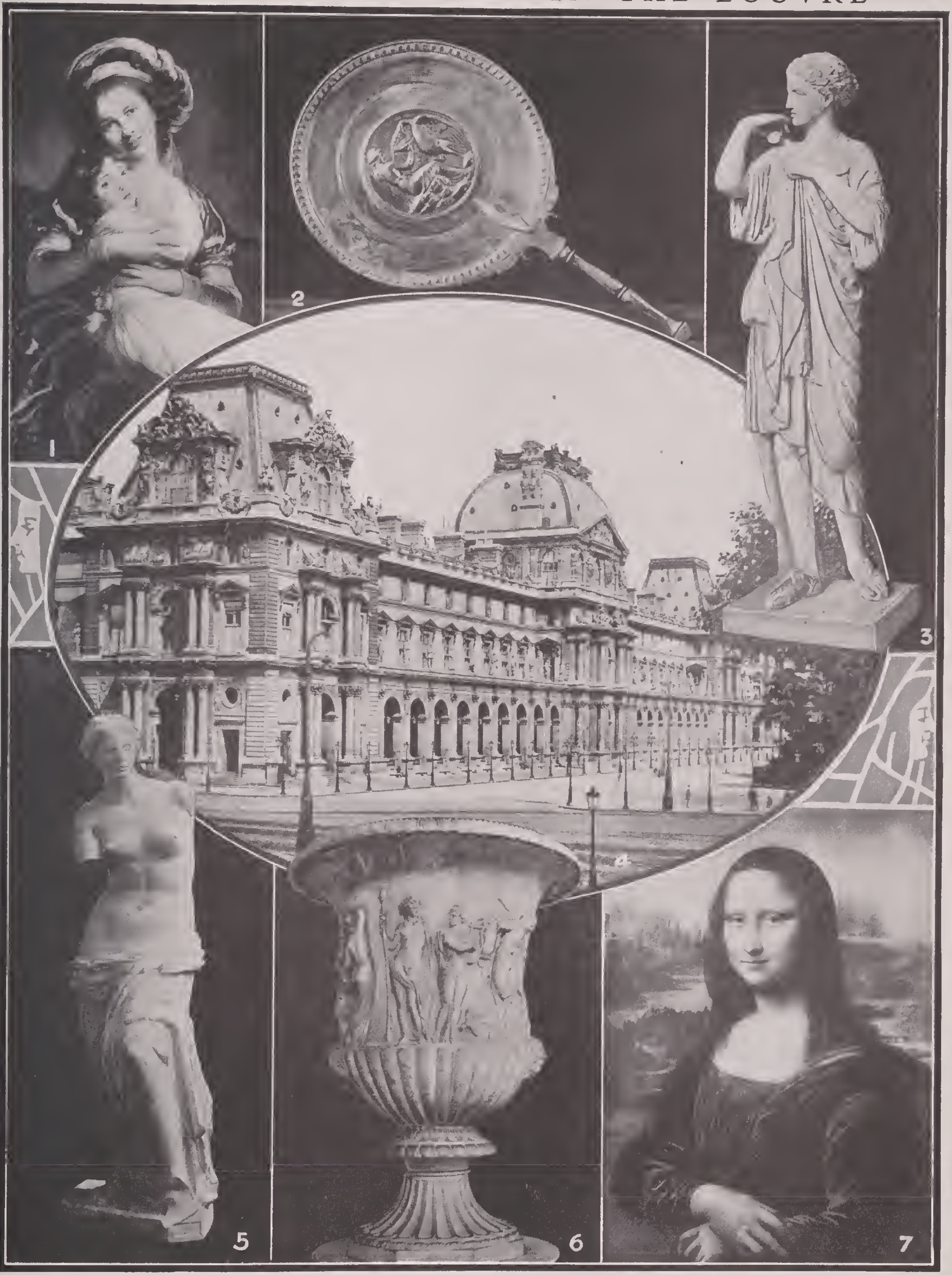
Wonderful it is that so much of the ancient world remains, and wonderful indeed that so much remains with its charm unspoiled! We must thank our Mother Earth for most of it, for she has covered up our treasures with the dust of centuries. She guarded them from Goth and Hun, from the wearing hand of Weather and Time, and nearly all our monuments of ages past have been rescued from the grave in which the earth protected them.

A building falls in ruin. The dust of ages covers it, and other men in other times discover what was lost. So there is preserved for us the evidence of life, the handicraft of men and women, from the days when human history began.

Imagination grows on things like these, and the mind runs back and thinks of what the world has been and of what mankind has seen since all these things were made.

We can hardly conceive the wealth of all this treasure that the toil of men has laid up for us. The great European museums are literally filled with treasures of beauty and wonders of antiquity far older than the United States. In them we walk for mile upon mile, and seem to be walking through the pages

ARISTOCRATS OF ART IN THE LOUVRE



The Louvre in Paris, once the palace of French kings, possesses one of the greatest collections of art treasures in the world. The central view (4) shows the north façade, where the Louvre faces the Tuileries gardens. The other pictures show a few of the more celebrated treasures: (1) Elizabetn Vigée Lebrun's portrait of herself and daughter; (2) ancient mirror; (3) ancient statue, the 'Artemis of Gabii'; (5) Venus de Milo; (6) Borghese vase; (7) 'La Gioconda', or 'Mona Lisa', by Leonardo da Vinci.

EXAMPLES OF THE MAGIC OF THE ARTIST'S SKILL

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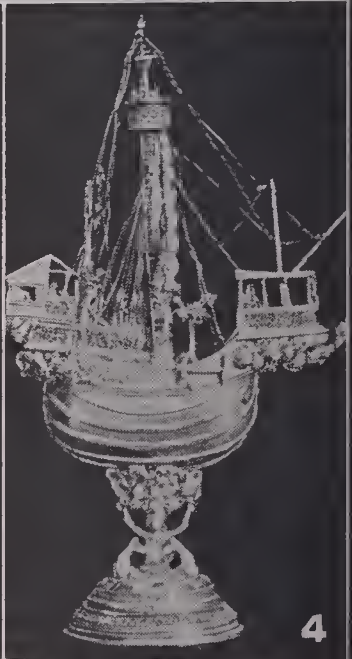
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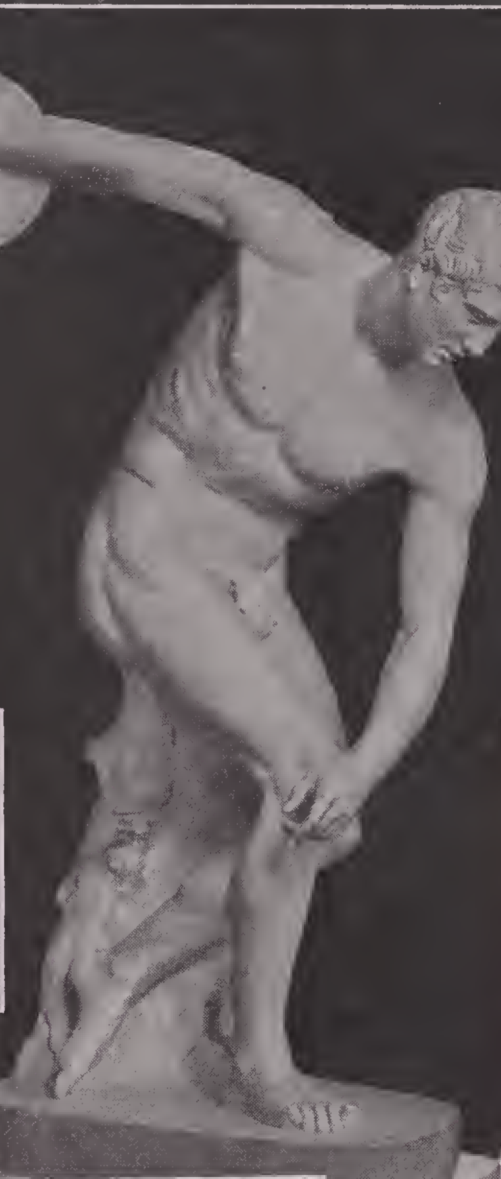
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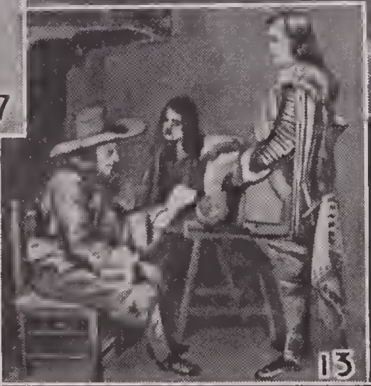
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Although all Europe is a storehouse of beautiful objects, Italy is by far the most munificently provided. This is why the examples shown above include more works from Italy than from any other country. The objects are as follows: (1) Greek statue of the goddess Flora, in the National Museum, Naples; (2) ivory casket, Catania; (3) equestrian statue of Captain Colleoni, by Verocchio, Venice; (4) censer, Church of St. Anthony, Padua; (5) ivory chair, Ravenna cathedral; (6) ancient vase, Naples; (7) vase, Florence; (8) 'Discus Thrower', Vatican, Rome; (9) and (10) candlesticks; (11) column; (12) beautifully carved casket, Milan; (13) painting, 'The Order', by Metsu, Dresden Art Gallery; (14) crown of Holy Roman Empire, 14th century; (15) door knocker recovered from the ruins of ancient Pompeii.

FROM THE ENDLESS VARIETY IN EUROPE'S TREASURY

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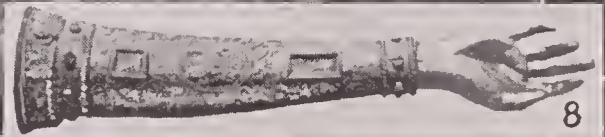
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(1) Pulpit in Cathedral of Pisa by Niccolo Pisano; (2) silver pitcher, by Benvenuto Cellini; (3) silver vase; (4) old candlestick; (5) statue of Diana in the Louvre, Paris; (6) reliquary, Cividale; (7) Greek statuary group, 'The Wrestlers', Florence; (8) jeweled arm and hand of metal, Catania; (9) sarcophagus of Empress Helena in Rome; (10) Roman chariot, Vatican, Rome; (11) crown of the 13th century, Namur cathedral, Belgium; (12) painting, 'The Dentist', by Gerard Dow, Dresden Art Gallery; (13) font at Parma; (14) painting, 'The Fortune Teller', Mieris, Dresden Art Gallery. The Italian eminence in art is easy to understand. Italy was heir of the Roman and Greek civilizations, and was also the birthplace of the Renaissance, so she has had the longest period in which to acquire treasures.

contained in the Easy Reference Fact-Index at the end of this work

SOME OF ENGLAND'S RELICS OF BYGONE CENTURIES

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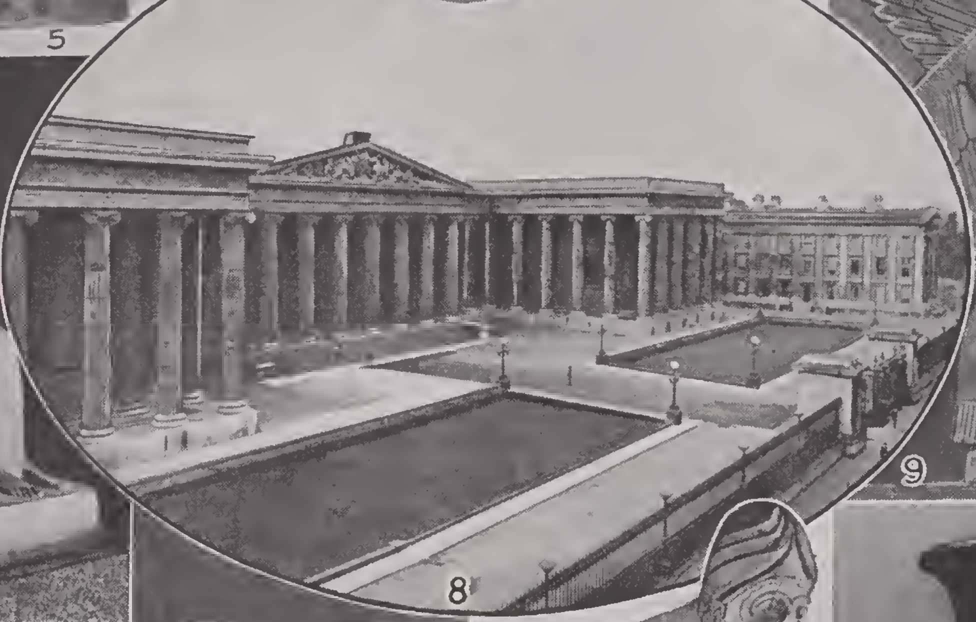
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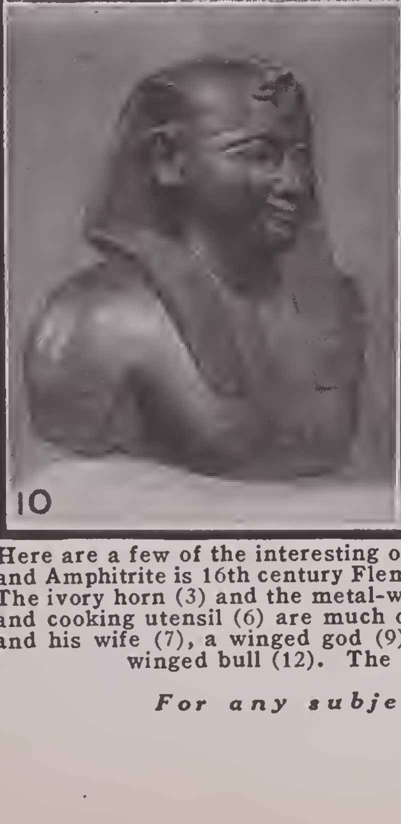
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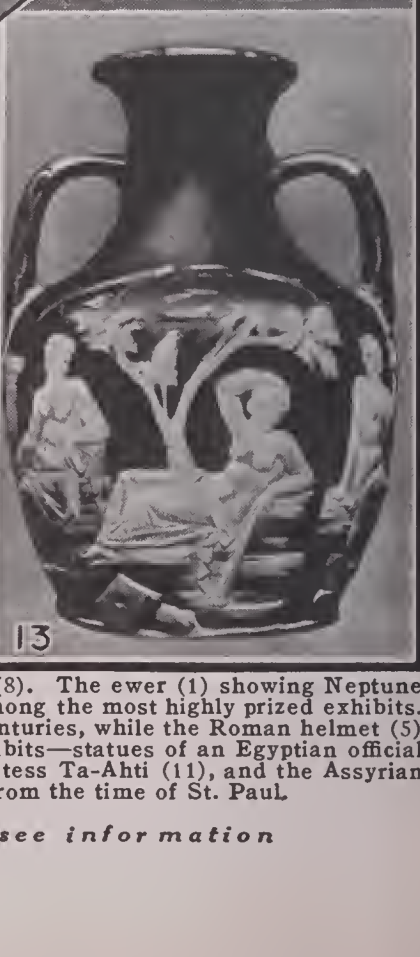
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Here are a few of the interesting objects in the British Museum, shown in the center picture (8). The ewer (1) showing Neptune and Amphitrite is 16th century Flemish work, while the portion of the Parthenon frieze (2) is among the most highly prized exhibits. The ivory horn (3) and the metal-work ewer from Mesopotamia (4) are of the 10th and 13th centuries, while the Roman helmet (5) and cooking utensil (6) are much older. But oldest of all are the Egyptian and Assyrian exhibits—statues of an Egyptian official and his wife (7), a winged god (9), the head of Ptolemy Auletes (10), the coffin of the priestess Ta-Ahti (11), and the Assyrian winged bull (12). The Portland vase (13), the most famous vase in the world, is from the time of St. Paul.

of a history book. We can go for a walk through history very near to Cromwell and Drake and Mary Queen of Scots, for we can read letters they wrote with their own hands; and at Oxford we can see a chair made from a piece of the ship in which Sir Francis Drake sailed around the world. We can see the things that Socrates and Plato saw; we can touch a thing St. Paul looked on; we can read the actual letter written by Anne Boleyn as her heart was beating high with the thought of marrying the Bluebeard King who murdered her.

The wealth of the museums of Europe is so immense that no man knows it, no gold can buy it. Treasure piled on treasure meets our gaze; wonder on wonder, tragedy on tragedy, all the emotions that come into life from the cradle to the grave stir in us as we walk through these great galleries. Gems that glitter like the sun; things so beautiful that they seem to belong to a world of dreams; marvelous products of the patience of Nature and the immense labor of men's hands; ghastly sights from which we turn away and shudder; memories of immortal deeds; the touch of Shakespeare and Michelangelo; a little thing King Alfred owned, something Cromwell wrote, and an actual part of the body of Napoleon; fragments of history from every age and every land; types of life from every clime; Nature in all her seasons and in all her glory and through all her generations; the books that men have written, the pictures they have painted, the statues they have carved—it is all here.

And it is all here for you and me, treasure untold that belongs to the world. It has come to us from the Past, to which we owe our priceless heritage; it belongs to this generation of the world to hold in trust and to be handed on to that far-off Future which all good men believe will be greater and greater yet.

EVAPORATION. An illustration of one of the biggest things in the world takes place when clothes dry on wash day. Evaporation makes the world fit to live in. It is the means by which water is drawn from the great ocean reservoir and from minor sources of moisture, to give the air its requisite humidity, to lessen the changes of temperature between day and night and between winter and summer, and to create the clouds that in their season give snow and rain to nurture crops and feed watercourses.

The air at any given temperature has a certain definite capacity for holding water vapor, somewhat as a sponge holds liquid water, and, like a sponge, the air takes water vapor from any exposed moist surface, rapidly if it is very dry, and more slowly if moist. In desert regions, rain may be seen to fall from the clouds, though not a drop reaches the ground. This is because the hot dry air drinks it up, or evaporates it. Desert plants protect themselves against the dry air by exposing as little surface as possible for evaporation. The cactus, for instance, presents a surface of dry spines and thick leathery lobes within which it seals up all the moisture it can gather. For the same reason some species of eucalpytus trees turn their large leaves edgewise to the sun. In more humid climates plants spread out vast evaporating surfaces. The leaves of a single tree may give off many gallons of water in a single day, in the form of water vapor.

The capacity of the air for water vapor increases as the temperature rises. At 50° F. a cubic foot of air can hold about 4 grains of water; at 80° it can hold nearly 11 grains, and at 100°, nearly 20 grains. The amount of water actually present in the air at a given temperature, divided by the amount of moisture it is capable of holding at that temperature, is called the *relative humidity*. At 50° F. air with 4 grains of moisture per cubic foot has a relative humidity of 100; but at 100° air with the same amount of moisture has a relative humidity of only 20. A relative humidity between 40 and 65 per cent is most healthful and comfortable for human beings and most other living things. Air drier than this, as in overheated winter apartments and offices, parches the skin and mucous membranes; air moister than this, as that of some sweltering summer days, does not evaporate perspiration rapidly enough to prevent a hot "sticky" uncomfortable feeling. (*See* Heating and Ventilation.)

One of the most important effects of evaporation is to lower the temperature. You are cooler on a hot day if you perspire freely, because the evaporation of the perspiration cools your skin. You are cooler in a breeze than in still air because a breeze facilitates evaporation. On prairie farms, where there is no ice in summer, perishable foods are kept sweet by wrapping the container in a wet cloth which dips into a pan of water. In Mexico, India, and other countries, drinking water is often cooled in large porous jars kept where they are exposed to the wind.

The rapid evaporation of many highly volatile liquids produces intense cold, where the evaporation of water merely chills. Have you ever dropped alcohol or benzine on your hand? Try one of them on a bit of cloth around the thermometer bulb, and notice how the mercury drops. The evaporation of ammonia is used in making artificial ice, and the intense numbing cold caused by the rapid evaporation of ether is used to produce local anesthesia. (*See* Dew; Fog; Rainfall; Snow.)

EVEREST, MOUNT. No one has yet climbed to the top of the earth—the summit of Mount Everest, the King of the Himalayas. Tibetans who live near ascend it as high as they dare for purposes of worship, and their artists picture it as ending in five snowy horns with cloud-capped peaks. But Europeans, who can see it only from afar because of the restrictive laws of Tibet and the native state of Nepal, are unable to distinguish anything but a white dome. The great altitude of this crowning peak is concealed by the height of the plateau from which it springs and the sea of pinnacles around it. Yet the loftiest mountain in Europe is little more than half as high as Everest, which towers 5½ miles (or 29,002 feet) above sea level. It was named in honor of Sir George Everest, the English official surveyor who first fixed its position and altitude. (*See* Himalaya Mountains.)

EVERGLADES. A vast tract of land and water which formerly occupied an area of 5,000 to 8,000 square miles in southernmost Florida, extending southward for 110 miles from Lake Okechobee and averaging 45 miles in width. A considerable part of it has recently been reclaimed by drainage. Settlers are finding a hidden store of treasure in the bountiful crops of oranges, bananas, pineapples, and other fruits, and vegetables which they can grow on these lands. (*See* Florida.)

EVERGREEN. A tree or plant which retains its foliage throughout the year, such as the pine, fir, hemlock, laurel, etc. Evergreens are in contrast with deciduous plants, which shed their leaves periodically and are leafless during part of the year. The term evergreen is often taken to mean any tree with cones and needles—in other words a conifer—as opposed to a broad-leaved tree; but not all conifers are evergreens; for examples the tamarack and the larch are clothed with needles and cones but shed their foliage in the fall. On the other hand, certain broad-leaved tropical or semi-tropical trees such as the laurel are evergreen, and do not lose their foliage in winter. (*See* Tree.)

LIFE'S *Endless* UNFOLDING *in the* PROCESS WE *Call* EVOLUTION

> *"THERE'S nothing new under the sun" is pretty much true of the evolution theory, as of so many things human. The idea is very old. According to the "doctrine of organic evolution," as we call it today, all the vast number of kinds of plants and animals that exist now or are found in the past history of the earth have come from the simple forms of life present very early in the earth's history. This means that the process of evolution has been going on for many millions of years. The changes have been very gradual, and the alterations in a thousand years would usually be comparatively slight.*

EVOLUTION. Native curiosity and interest in the phenomena of nature are fundamental qualities of the human mind. So we may be sure that long before the times of recorded history—perhaps many thousands of years before the discovery of writing to preserve men's thoughts—men began to ask themselves the whence and why of the living things about them. In those dim times of the remote past, much progress was made in taming for man's use both animals and plants, some for man's utility and some for his pleasure as companions or ornaments. These things about the homes of early men became much changed from the wild animals and plants that man knew, and we may be sure that the active minds of our remote ancestors wondered if Dame Nature had not also performed many experiments in changing the plants and animals under her charge.

The earliest record of attempts to explain the changes of living things into other living things were those of the ancient Greeks six or seven centuries before Christ. Aristotle, the great master in the study of life in the 4th century B.C., had a clear idea that the higher forms of life had come from the lower. But such views were crippled, as viewed from our modern standpoint, by the general belief of those times that even higher forms (such as frogs) might arise spontaneously from non-living matter.

There have been many popular misunderstandings of evolution. One is that Charles Darwin was the "father of evolution." While we properly think of him as the great modern exponent and advocate of the doctrine, there had been a number of very able believers in evolution before the publication of Darwin's 'Origin of Species' in 1859—Lamarck in France (1744–1829) being the most notable of these. Another mistake is that Darwinism and evolution in general are the same, which is far from true. For, as we shall see later, while thinking people generally have accepted evolution, they are divided as to how evolution has taken place, and Darwinism is only one explanation. The whole matter of evolution is extremely complex, and it is very natural that many things should have been changed since Darwin's time, and that his explanations should be less accepted now than 50 years ago.

Some Common Misconceptions

Another mistake is that the doctrine of evolution is less accepted now than formerly. While it is true that Darwin's particular explanation is less accepted, the doctrine of evolution in general is more generally accepted than ever before, and more firmly believed than ever before by scientific men. Again, it has frequently been thought that evolution deals chiefly with the descent of "men from monkeys." While the evolution doctrine includes the development of man, this is but part of the grand general process which accounts for the origin of all living things from other and simpler forms of life. Still another mistake is that we should see evolution taking place as an everyday occurrence. Man has worked wonders in changing wild animals and plants into his domestic forms of many varieties; but this has taken thousands of years, and evolution in general has taken many millions of years. The acceptance of evolution has been general for only 50 years or less, and while some changes have been observed in that time, they have not been very extensive. These 50 years are as but a second compared with the time life has existed.

The term "evolution" is frequently used rather loosely, as meaning the same as "organic evolution." Evolution alone should be used for the whole process of the origin of worlds, of our solar system, for instance, as well as for the origin of living things. But the evolution of worlds is very slow, taking perhaps hundreds of millions of years for our solar system to develop to its present state from the original nebulae or star dust which gave rise to it. (*See* Planets; Sun and Solar System.) Eventually the earth was formed, but for ages of time it was a very hot ball—so hot that all of the water now found in the seas was driven off from the earth in the form of a vast blanket of vapor around the earth hundreds of miles high. Finally the earth became cool enough and adapted to the presence of simple forms of life. It was then that organic evolution began and it has continued ever since. Throughout the ages life has been struggling upwards, higher and higher in form and complexity, till we have now the many kinds of living things that inhabit the earth. (*See* Earth.)

How long has life been on the earth? Nobody knows very exactly. There have been several ways of estimating it, and some authorities think 50,000,000 years, some as much as 100,000,000 or more. But all scientists think it has been an "infinitely long" time, beyond the grasp of the human mind.

You will wish to know why scientists have accepted the doctrine of organic evolution for the origin of living things, to know what are the evidences for the doctrine. Only a very few of the vast number of illustrations can be cited from the mass of evidence that science has gathered.

What the Fossils Teach Us

Paleontology—the science of the fossils found in the rocks of the earth—gives us two types of evidence (*see* Fossils). First, that the early rocks contain fossils of the lower forms of life in great variety and abundance, but none of the higher. There were no backboned animals (vertebrates) in the world at that time. They came only millions of years later, first only the primitive fishes. Later, through succeeding millions of years, amphibia (frogs and their kin) came; and then in succession early reptiles and the early birds and mammals. The early mammals gave rise to the many forms of hairy animals we know now, through perhaps 5,000,000 or 10,000,000 years. All along the line of evolution science shows that many forms of life have come into the world and vanished. This is especially striking in the case of reptiles. Through millions of years they were evolving. More than 20 orders of them were present at one time, "lords of the earth" during the millions of years called the "Age of Reptiles." (*See* Animals, Prehistoric.) Then, with the evolution of mammals, the reptiles grew less, till now there remain but five of the orders of reptiles.

The study of fossils also shows, in a few cases, the certain evolution of some types. This is very clear in the case of the horse—in which each foot retains only the middle finger or toe, with its nail greatly enlarged to form the hoof. We begin with horselike animals the size of foxes, which had all five fingers and toes on the feet. From these science traces a dozen stages, changing more and more through several millions of years, till the modern horse is developed. Has science traced the history of many forms, as clearly as it has that of the horse? No. Consider for a moment the formation of fossils. Of course, the simplest forms of life did not leave fossils, for they had no hard parts to fossilize. Again, even among animals with hard parts, it is the rare individual that has a chance to form a fossil—the vast majority are eaten, or otherwise disappear. And of the ones saved as fossils, man has found but a small proportion, for he can explore but a few specks, as it were, of the earth's crust. The horse, however, is sufficient to prove the general principle of evolution.

The study of the comparative anatomy of animals also supplies much evidence for evolution. Just two or three citations, from the thousands that might be given. From low fishes to the highest animals, all vertebrates show the same *plan* of the brain, with nerves from the brain supplying the same parts of the head in all. Again, take the limbs of mammals or hairy animals. They are all built on the same plan. The bat's wing, for instance, has the same chief bones as the arm and hand of man. Yet how different in outward appearance! And so, case after case might be cited from the animal and plant kingdoms.

How Man is Linked to the Fish

From embryology, or the development of animals and plants from egg cells, much evidence could be given (*see* Embryology). The principles are the same for all of the common forms of life—for an insect as for a mammal. The following type of evidence is especially striking: the highest forms of life tend to pass through the same stages in developing from the egg as they have in their evolution from the lower forms of life. The human embryo, for instance, when very small, has holes along the sides of the throat, like those of a fish. But they are perfectly useless and disappear long before birth. There are also other fishlike characters, suggesting the far-back origin of men from fishes.

In the study of such "rudiments" many surprising things are explainable only on the supposition that the animals with the rudiments were evolved from more primitive animals that had the same organs in a useful condition. These two among many: Mammals in general have the same two sets of teeth as has man. The whalebone whale has these two sets of teeth—only both sets are developed and *lost* before the little whale is born, and are never used at all! Again, the "vermiform appendix" in man's digestive tract is a rudiment, worse than useless; but it is the remnant of an organ that is useful in many other mammals. There are many such rudiments in man's body, perhaps a hundred of them inherited from the past, where they once were useful.

The study of the physiology of different animals also shows many striking similarities. Take the higher animals, for instance. They all do about the same things—nourish themselves, breathe, reproduce their kind, use the same general kinds of foods, form the same kinds of wastes, and many other things. The most striking illustrations of these similarities are shown among the common higher animals, where scientists have made many discoveries of very great importance in medicine and surgery. We have all heard of "vitamins"—mysterious materials of several kinds which are equally necessary to the health of man and other higher forms of animal life. Most of our knowledge of these substances has been learned first from studies on other higher animals, and later applied to man himself.

Domestic animals and plants show how man, by artificial selection or breeding, has very profoundly changed—or "evolved"—many of our common forms of life. Among chickens, for instance, the variety is so great that, if the different kinds were found in nature, they would easily be classed as different kinds of animals; for instance, the great "brahmas," weighing ten pounds or more, and the tiny "bantams," weighing but a pound. Yet all are derived from the same wild fowl of India. Again, if we were to come upon various kinds of cabbage, kale, cauliflower, Brussels sprouts, and Swedish turnips in nature, we would easily say they were altogether different kinds of plants. Yet man has derived them all from the same wild plant. (*See* Cabbage.) These two citations are very striking, but a great many others from domestic varieties might be given. Horses, cattle, dogs, sheep, various kinds of flowers, will occur to all.

The explanation as to *how* evolution of living things has taken place is the more difficult matter. For, while biologists are all agreed that evolution has taken place, they are far from agreeing as to the processes involved. We may perhaps best begin with Darwin's explanation, and then trace briefly the changes in scientific opinion since his time.

The "Survival of the Fittest"

There are a few great corner-stones of Darwinism. First, we have to consider the *materials* with which evolution has had to work. These are the differences among the individuals of any kind of animal or plant. It is familiar to all that no two individuals are ever exactly alike. We notice the differences most clearly among people, mostly because we examine people more critically than we do other animals. But the same principle holds for any kind of animal or plant. Take wild rabbits, for example. They differ in size, color, and other characters. Some are better adapted for living in their surroundings, some not so well. Now, more young animals are born than can grow and reproduce their kind. In many species of animals and plants, thousands—even millions—come into the world from two parents. A toad, for instance, lays 20,000 eggs each year. But as soon as laid the losses begin. Some of the eggs perish or are destroyed; later, some of the tadpoles are killed and eaten by other animals; later still the little toads perish, till eventually only two, on an average, are left to take the place of the two parents. That is where "natural selection" comes in to cull out the less good, and to preserve the ones best fitted for the toad's surroundings. That is, there will result the "survival of the fittest." And so, generation after generation, the same thing will take place, with the result that the species is gradually better and better fitted for its place and conditions of life.

The most difficult part of the explanation is to see how an improved kind or species of animals will break up into two or more species. For, if one species makes two or more, with more and more lapse of time, greater and greater variety will result. It was in this way that Darwin supposed the whole living world was evolved, with the passing of millions of years. Several explanations have been offered, but they are rather too difficult to give here.

One of the great fighting grounds of evolution has been as to the nature of diversities or differences among animals and plants of any species (whether small or great), and their causes. According to Darwinism, the effective differences are usually small, and are caused largely fortuitously (without known causes); in smaller measure they are caused by the transmission from parent to offspring of the modifications of the parent during its lifetime.

It will be interesting now to examine briefly two or three more modern views. The "Lamarckians" (who bring Lamarck's chief views up to date) believe that the differences among the individuals of any kind of plant or animal arise because the parent passes on the acquisitions of its lifetime to its offspring. As applied to man, an athlete would have children stronger physically than his fellows; an educated man, children with better intellect, etc. The children in each case would be better by nature. And so for a thousand things that one may imagine. But the followers of August Weismann (1834–1914) believe that the developments of the parent will not show in the nature of the offspring at birth. It seems the followers of Weismann have the better argument, and that the child will not inherit the *changes* that have come into the life of the parent. For instance, the feet of Chinese women are of normal size if let grow, though Chinese women have bound their feet for thousands of years. Many similar cases might be cited, showing that the changes are not passed from parent to child.

Still another view is that nature has taken advantage of the "sports" or "mutations"—that is specimens remarkably different from their fellows—that from time to time are born or spring up in any species of animal or plant. Such a mutation is seen in a person with two joints in the fingers instead of the usual three; or with six fingers and toes, instead of the usual five. Many of these mutations have been observed in both animals and plants, and it may be that they become the chief materials for the origin of new species; and, with the lapse of time, of more and more variety among animals and plants.

There are still other theories as to the causes of organic evolution, but the ones here given show some of the points in dispute. It must be repeated, however, that while there are differences of opinion as to the *method* of evolution, the *fact* of evolution is believed by scientists more firmly than ever before.

MODERN TITANS *with which Man* MOVES MOUNTAINS

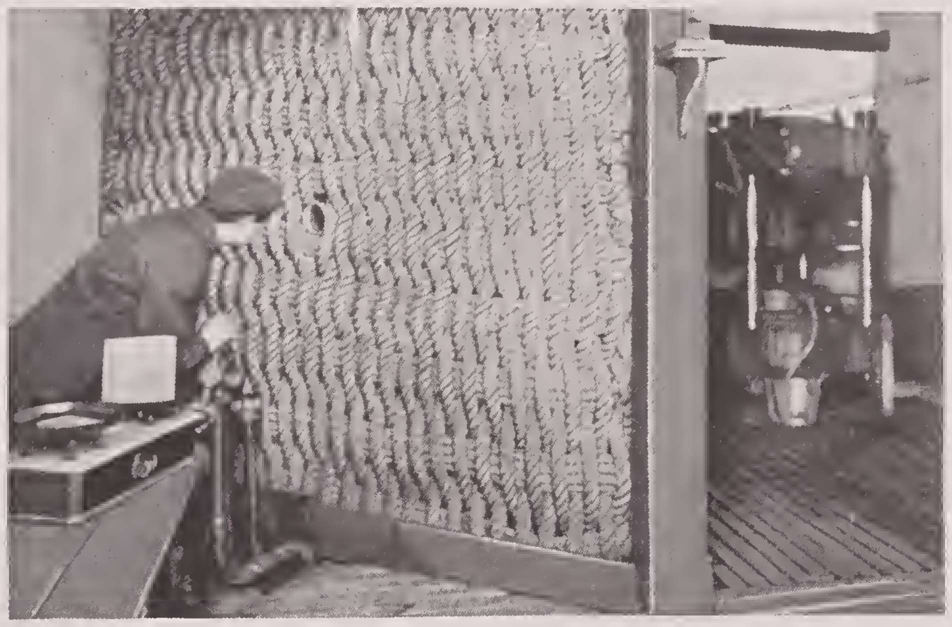
On Oct. 10, 1885, a group of men sat in a wooden cabin overlooking Hell Gate, the narrow passage in the East River which connects Long Island Sound with New York harbor. Half-way across stretched Flood Rock, making a dangerous barrier to navigation. One of the men pressed an electric key. The ground trembled; there was a rolling muffled roar. The vast bulk of Flood Rock rose slightly, then fell and vanished. Within a minute, 25 feet of churning muddy water was flowing over the spot where the rock had stood. Imagine a solid mass of stone as big as a city block and 15 stories high blasted away in less than 60 seconds! What is the mighty power that did this work? Nothing but "chained wind"—the expansive power of gases suddenly set free, about which this article tells you.

EXPLOSIVES. The gases that explosives release when they "let go" are the most powerful force under man's control. The pressure developed by ordinary gunpowder, when fired in a space which it completely fills, is more than 6,000 times that of the atmosphere. When we realize that the "high explosives," such as guncotton, dynamite, nitroglycerin, mercury fulminate, and scores of others, are from four to six times as powerful as gunpowder, we see what an amazing force has come into men's hands. Mercury fulminate is the most violent of all the explosives in practical use, for it develops under proper conditions a pressure of 200 tons per square inch. The strongest cannon-barrel ever made would fly into pieces under such a pressure.

What causes the sudden release of gases which we call an explosion? To understand this we must first realize that many solids and liquids are composed in whole or in part of substances which ordinarily are gases. Water, for instance, consists of the gases hydrogen and oxygen; mercury fulminate is composed of mercury, carbon, and the gases nitrogen and oxygen. Water is not explosive, while mercury fulminate is. This is because the hydrogen and oxygen which form the water are very "friendly" to each other—they are linked by a strong chemical attraction and cannot be easily separated; while mercury fulminate is an unstable compound and its components do not get along well together—they are constantly looking for an excuse to split up. If struck or rubbed or pressed, they fly apart very suddenly.

Instead of the solid mercury fulminate, therefore, we have two gases—nitrogen and carbon monoxide—and mercury vapor, which occupy vastly more space now they are separated than they did when combined. It is the sudden and violent moving of the gases and vapors into this new space that constitutes the explosion. These gases are like "unchained winds."

''SAFETY FIRST'' IN MAKING GUNCOTTON



In the corner to the right is a press used in making the high explosive guncotton. It must be tended like any other piece of machinery, but since guncotton has a way of exploding "out of turn" every now and then, the job of running the press is not a popular one. The difficulty is solved in part by the rope screen with the peep hole. Here the operator takes shelter with his controls, and in case of accident, has a chance for his life.

Any substance which breaks up easily and suddenly, producing a large volume of gas, is an explosive. There are some, like nitrogen iodide, which are so sensitive they will explode at the tread of a fly or the touch of a feather. There are others which require a hot flame to set them off.

Broadly speaking, explosions may be of two kinds—extremely *rapid burning*, as in the case of gunpowder, and *detonating*, as in the case of mercury fulminate or nitroglycerin. In the first case, the flame starts in one spot and spreads quickly over the entire mass. In the case of detonation, however, a shock or jar causes all parts of the substance to "let go" at virtually the same time. Guncotton illustrates both kinds of explosion. If set off by a flame it will usually burn rapidly, creating a large quantity of gas, but without exhibiting extreme violence. If, however, a cap or primer or fuse made of some detonating substance like mercury fulminate be set off in contact with the guncotton, the latter will in turn be detonated. The ordinary dynamite stick can be set on fire with a match without great danger, but will explode with shattering force in response to a fulminate cap.

Since the first form of explosion is merely extremely rapid burning, it follows that any inflammable substance can become more or less explosive if it can be made to burn rapidly enough. Since all ordinary fire or combustion is caused by the combination of the burning substance with the gas oxygen (*see* Oxygen), it follows also that the more oxygen is present the faster will be the blaze. For example, coal gas, hydrogen, and the vapors of gasoline, alcohol, ether, turpentine, etc., are themselves non-explosive, but they become explosive if they are mixed in the right proportions with the oxygen of the air. The loud back-firing so frequent in a gas stove is caused when too large a supply of air is admitted to the gas pipe through the vent. This principle of explosive mixture of gases and vapors with air is used in the automobile and all gas engines (*see* Gas Engine).

Many serious accidents have arisen from so-called "dust explosions." When the air is filled with finely powdered charcoal, coal, flour, soap, wood, sugar, starch, or any other combustible substance, the flame of a match may start a blaze, which will travel through the dust cloud so rapidly that it creates a violent and destructive blast.

Explosives which are to be used for practical purposes, however, cannot depend upon the air for their supply of oxygen. It must be provided in concentrated form so as to be available even when the explosive is excluded from contact with the air. In black gunpowder, which is a mixture of charcoal, saltpeter, and sulphur, the saltpeter (potassium nitrate) provides the necessary oxygen (*see* Gunpowder). But most explosives are true compounds, in which each molecule contains the oxygen necessary for the explosion. A few of the detonating explosives, such as nitrogen iodide, contain no oxygen; their action does not depend upon combustion, but upon the simple splitting away of the different parts of the compound, and their expansion under heat.

The Rôle of the "Unsociable" Nitrogen

Virtually all explosives contain nitrogen. This gas is one of the most "unsociable" of all substances, and in its desire to "get away" by itself, it is usually ready to break up any company of chemicals of which it may form a part (*see* Nitrogen). In the manufacture of the high explosives, nitrogen is usually introduced through the action of nitric acid. Thus, with some cellulose substance like common cotton, nitric acid forms guncotton; with glycerin, it forms nitroglycerin; with carbolic and sulphuric acid it forms picric acid, the base of such famous military powders as lyddite, melinite, etc.; with toluene obtained from coal-tar, it forms trinitrotoluene or trinitrotoluol (T.N.T.), one of the commonest and most powerful of military high explosives. Dynamites are mixtures of nitroglycerin with some absorbent substance which tempers its sensitive violence (*see* Dynamite and Nitroglycerin).

High explosives in their pure state are used as bursting charges in shells, but they are too violent to be employed as propelling charges in firearms. For this purpose numerous kinds of smokeless powders are manufactured, most of them consisting of some nitrocellulose like guncotton dissolved into a gelatin and then dried and cut into regular grains or chipped into flakes, or formed into long fibers or cords. Some, like cordite and ballistite, contain a proportion of nitroglycerin.

Getting "Smooth" Explosions

These powders, while less violent than the high explosives, are much more powerful than black powder and have the additional military advantage of producing little or no smoke. At the beginning of the explosion they are comparatively slow burning and start the bullet or shot smoothly on its way, gradually increasing the pressure and speed as the projectile nears the muzzle, and reaching the maximum power at the moment of discharge. The speed with which these powders burn is also controlled by the shape and size of the grains—large smooth grains burning more slowly than small rough ones, and giving therefore a more gradual expansion of the explosive gases.

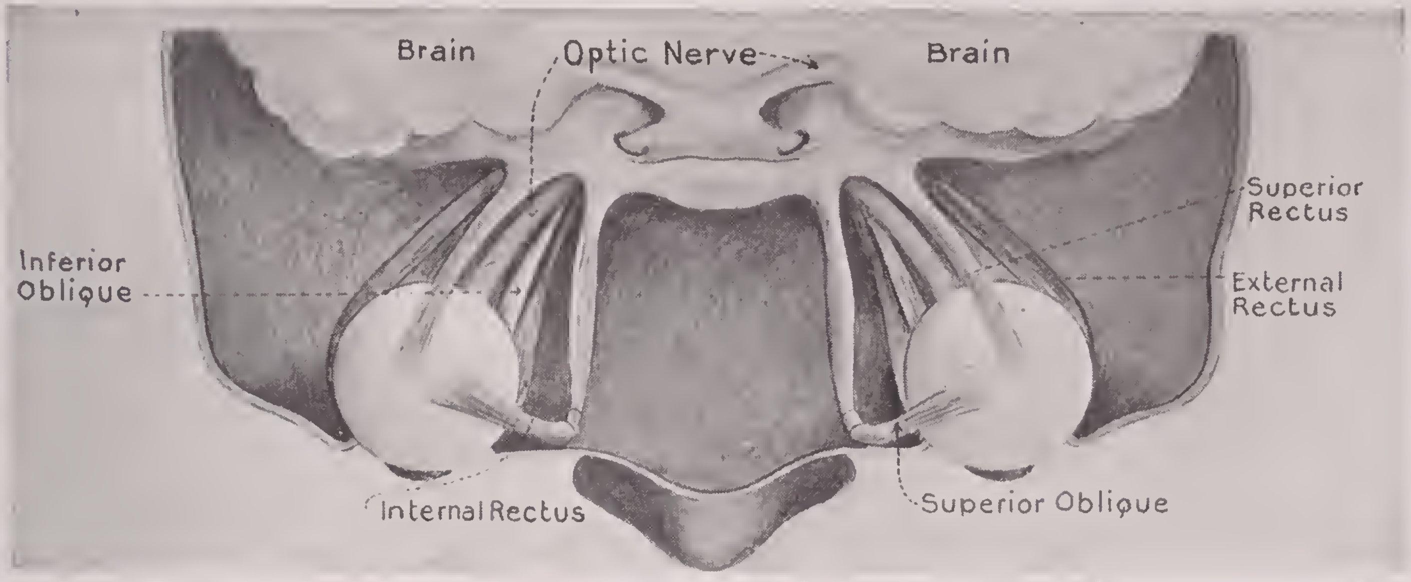
This smooth and gradual increase in velocity is of the utmost importance in firing shells filled with high explosives, for a sudden and violent shock might well explode such shells before they left the gun. As it is, the high explosive shells are equipped with detonators, which set off the bursting charge when the shell strikes its mark, or with time fuses which cause the explosion a certain time after the shell has left the muzzle of the gun.

Besides their destructive use in warfare and hunting, explosives are of immense value in scores of peaceful pursuits—in mining, quarrying, and engineering enterprises, in making fireworks, signal lights, and rockets. They are used to project lifelines to ships in distress off storm-beaten shores or to the roofs of burning buildings; to cast oil upon rough seas or to break up ice-jams. When pile drivers are not available, their work can be done by exploding dynamite on an iron plate placed on top of the piles. Floating derelicts which endanger ships at sea are destroyed with explosives, and great fires are halted by blowing up buildings in their path. Farmers use them for breaking up bowlders, blowing out stumps, felling trees, and loosening the soil for deep cultivation.

Most nations and states, however, find it necessary to regulate carefully the sale of explosives, for in the hands of lawless persons they are powerful instruments of crime, such as blowing open safes and vaults by "cracksmen," or making bombs and "infernal machines" by political fanatics and others. (For the history of explosives *see* Gunpowder.)

WHAT HAPPENS *when We* "SEE" THINGS

The Marvelous Instrument that Picks up the Messages of Light and Carries Them to Our Brain—Its Complicated Structure of Lens, Iris, and Retina—Keeping Our Eyes Healthy



Imagine that you are inside your own forehead, looking down upon the machinery of the eyes. That's the tip of your nose pointing to the bottom of the page, and those two white spheres are the eyeballs. Notice how the muscles are attached, which enable you to turn your eyes up and down, from side to side, and even to rotate them. In the midst of the network of muscles you see the two optic nerves running back to the brain.

EYE. We might call the eye the camera or picture-taking machine of the body—a picture-taking machine which we have always with us, but which unfortunately is not always in perfect repair. Sometimes the lens isn't true, or it may be that the shutter does not work, or perhaps the film or plate is poor. The result is that the picture is indistinct, distorted, or untrue, or possibly there is no picture at all. The picture which the photographic camera makes will last as long as the materials of which the film or plate is made; but the picture which the eye takes is a constantly changing and fleeting one, preserved only in the haphazard memories impressed upon our minds.

The eye, whether it be the eye of a man, of a cat, of a fish, or of a hawk, is specially made for use in the place where the animal lives. For example, in the daytime the pupil of the cat's eye looks like a narrow slit because the curtain has been drawn nearly to in order to shut out the light. The eyes of the owl, when he hunts by night, have the curtain pulled way back, to admit all the light there is. The dragon-fly, whose eyes seem to pop right out of its head, has many thousands of facets or little eyes in each eye, in order that it may see in any direction. The fish, which lives in deep water, often at the bottom of the stream or lake, has its eyes placed well toward the top of its head, looking upward as well as sideways. Again, the hawk, which gets its living by darting upon its prey, must have its eyes so made that it can rapidly change the focus and take a true picture at constantly changing distances; otherwise it would not get the chicken that it darts after from on high.

Now this camera of the human body (the eyeball) resembles a sphere with a bulge on the front, where the light enters. Six muscles, four straight and two oblique, are fastened to the outside of this ball, so that it may be turned up or down, to the right or to the left, or slightly rotated; thus giving a large field of vision without turning the head.

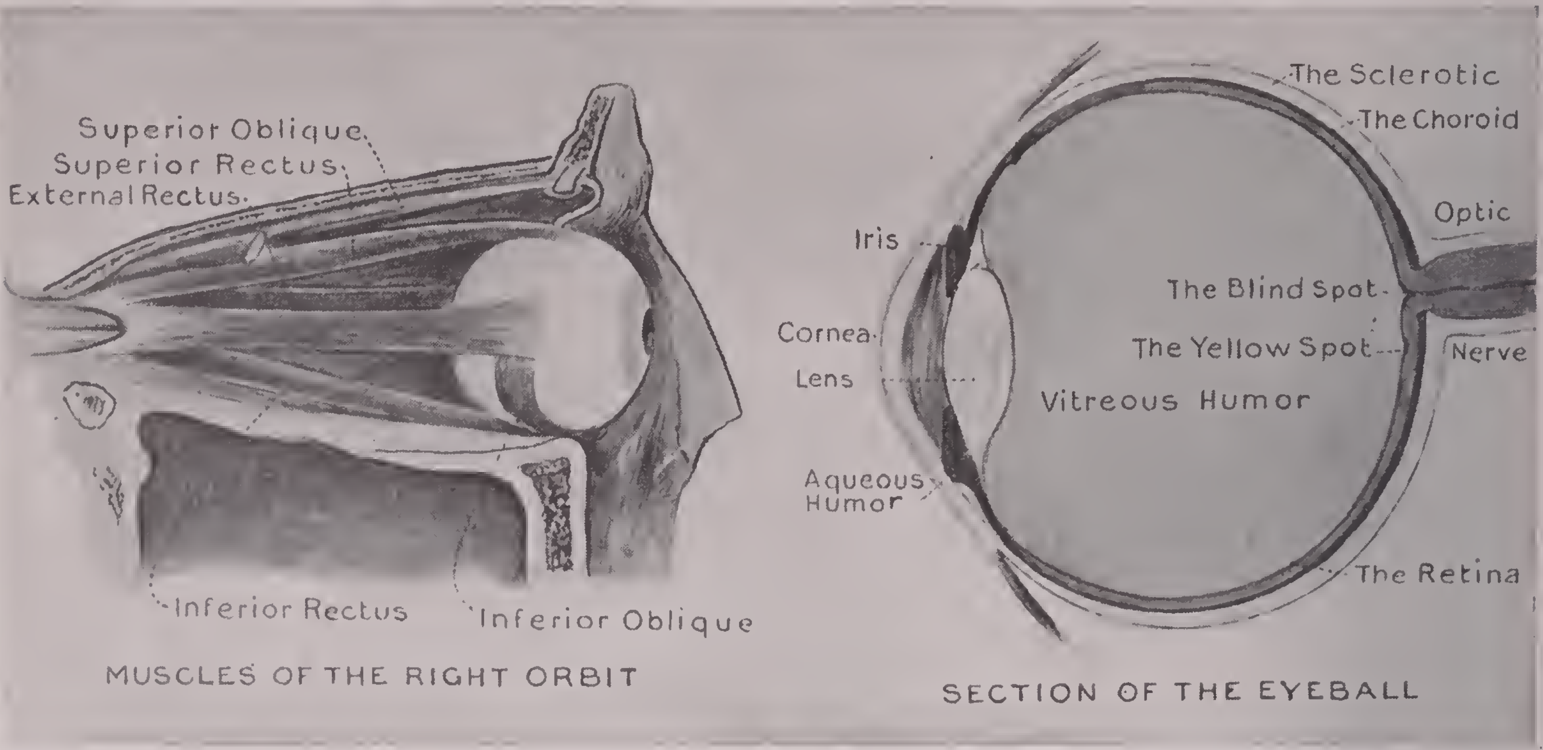
The outside coat of this ball—known as the *sclerotic* coat, and seen as the "white" of the eye—is tough and strong. The bulge in front is transparent and is called the *cornea;* it is really the "window" of the eye. Just underneath this tough sclerotic coat lies the dark middle or *choroid* coat; which carries the blood-vessels which nourish the eyeball. The choroid bends away from the cornea in front to form a colored curtain (black or brown or gray or blue, just as your eyes happen to be) called the *iris;* and in the center of this iris is an opening known as the *pupil.* Circular and radiating muscles control the size of this opening, according as you need more or less light—doing the very same work that the shutter of your camera does.

The inside lining of the eyeball—extremely thin and delicate, yet very complex in structure—is called the *retina;* and upon this surface the picture is printed "upside down."

From the retina spring nerve fibers which are gathered together to form the *optic nerve.* This leaves the eyeball at the back, and passes to the brain. The endings of these fibers in the retina are stimulated by light and through the fibers the sensation of sight is aroused in the brain. The nerve fibers are not themselves sensitive to the light, hence where they come together to form the optic nerve we have what is known as the "blind spot" of the eye.

The center of this hollow ball is occupied by the

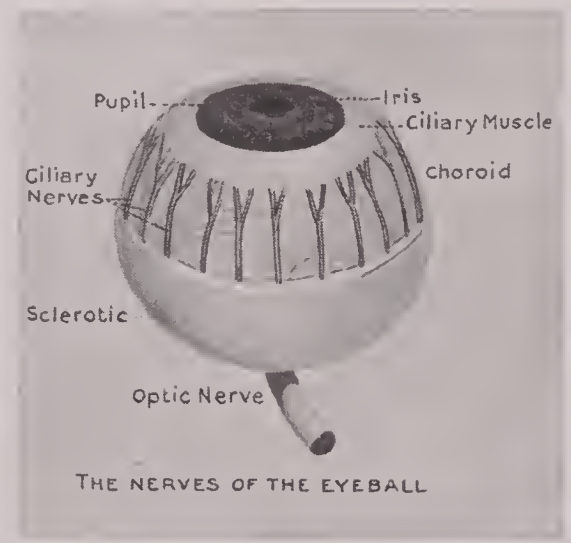
MECHANISM OF THE "LIVING CAMERA" IN OUR HEADS



To the left is a picture showing how the eye may be turned toward any external object by means of its muscles. A pull upon the "external rectus," for example, turns the right eye to the right. The other picture shows a section of the eye from front to back, and shows how like a camera it really is. The cornea is the protecting window in front, while the colored iris is the shutter. Muscles attached to the lens pull its edges apart and flatten it, or relax and let the lens thicken, as a means of adjusting focus. The retina is the "photographic plate," for it "registers" the light for the brain. Since the retina does not register light where the optic nerve enters the eyeball, we have a "blind spot" in our eyes. The yellow spot is where light strikes when the eye is looking straight ahead, and is the point of keenest vision. The "aqueous humor" is a liquid lying between the cornea and the lens; the "vitreous humor" fills the eyeball.

lenses. In front, between the cornea and the iris and pupil, is the *aqueous humor*, a clear transparent liquid. Immediately behind the pupil is the *crystalline lens*, a solid which contracts and expands as we look at nearby or distant objects. Back of this and occupying the greater part of the eyeball is the *vitreous humor*, a jelly-like substance which, as its name implies, is "glasslike" in its transparency. The word "humor" in this sense merely means one of the fluids of the body. Their purpose is to keep the eyeball filled out to the proper shape at all times.

HOW THE "SHUTTER" IS CONTROLLED



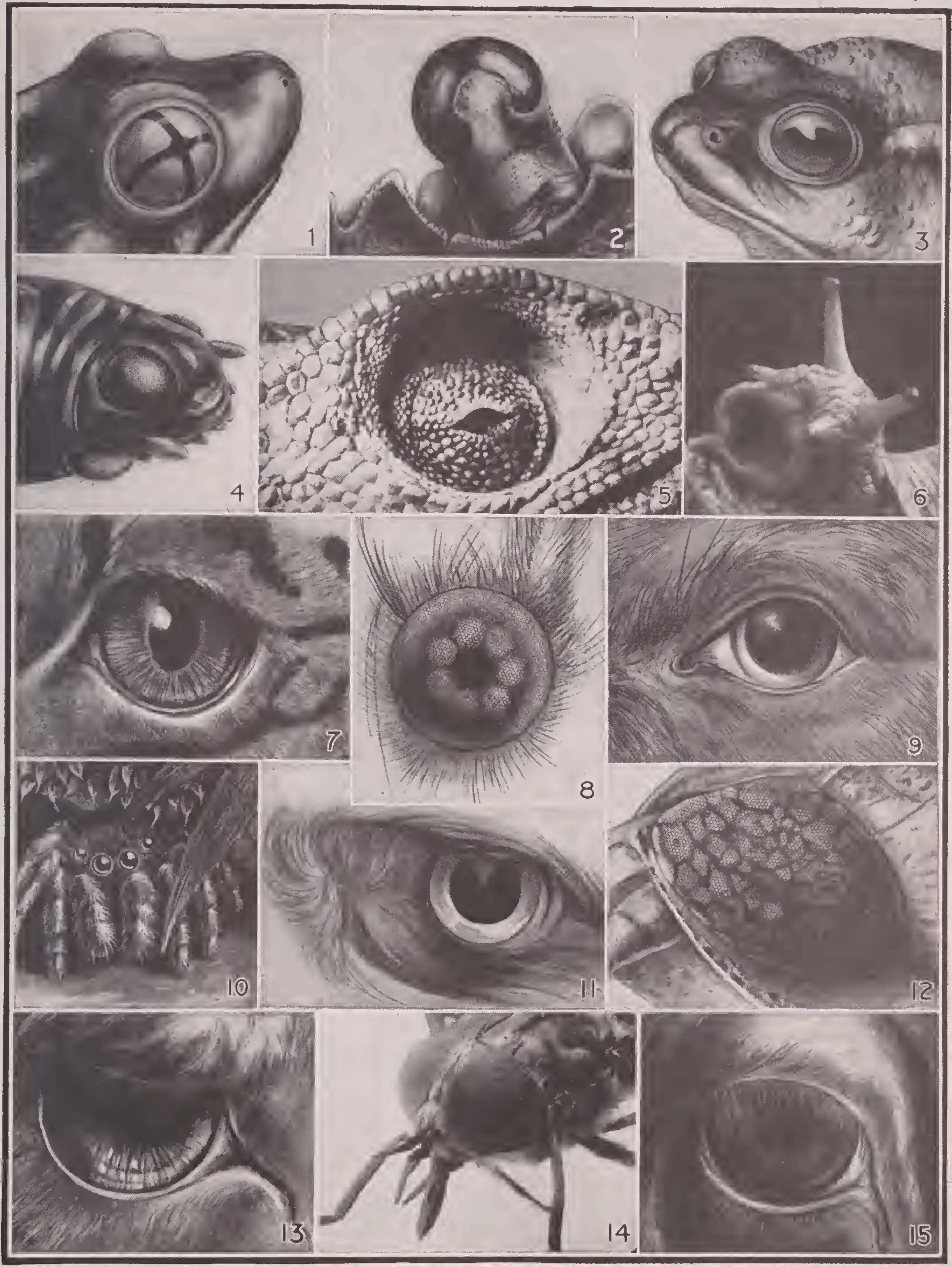
When the ciliary muscle contracts it draws the iris back and causes the pupil to enlarge and admit more light. When it relaxes, the iris opening contracts and cuts off excessive light.

Now what happens when we "see" an object is this: The rays of light from that object enter the pupil, pass through the aqueous humor, crystalline lens, and vitreous humor, and strike the retina at the back. These rays of light are so deflected or turned aside, in passing through the lenses, as to form an inverted or upside-down picture on the retina. The picture itself is not carried to the brain, but each part of the retina is stimulated strongly or weakly and by this or that color, depending on what part of the picture falls upon it. Therefore each fiber carries an influence or impulse corresponding to the light which stimulated it. These thousands of impulses correspond to the picture and are carried to the brain by the optic nerve. There the proper meaning is given, and we say we "see" a house, a dog, or a street-car. In reality, it is the *brain* and not the eye that does the seeing. A useful comparison is the telephone. It is not the voice that goes over the wires, but electric currents, corresponding to the voice. These currents are reconverted into sound in the receiver. So it is not light that goes over the optic nerve but nerve currents corresponding to the light, and these nerve currents cause the sensation of sight in the brain.

Often various parts of the human eye are abnormal. Sometimes the ball is too long or too short and the person is near-sighted or far-sighted, as the case may be. The cornea may not be a section of a true sphere, hence the picture is untrue, a condition called astigmatism. Sometimes these abnormal conditions are caused by ourselves; either we are careless in the way we use this camera, or else we do not know how to protect it.

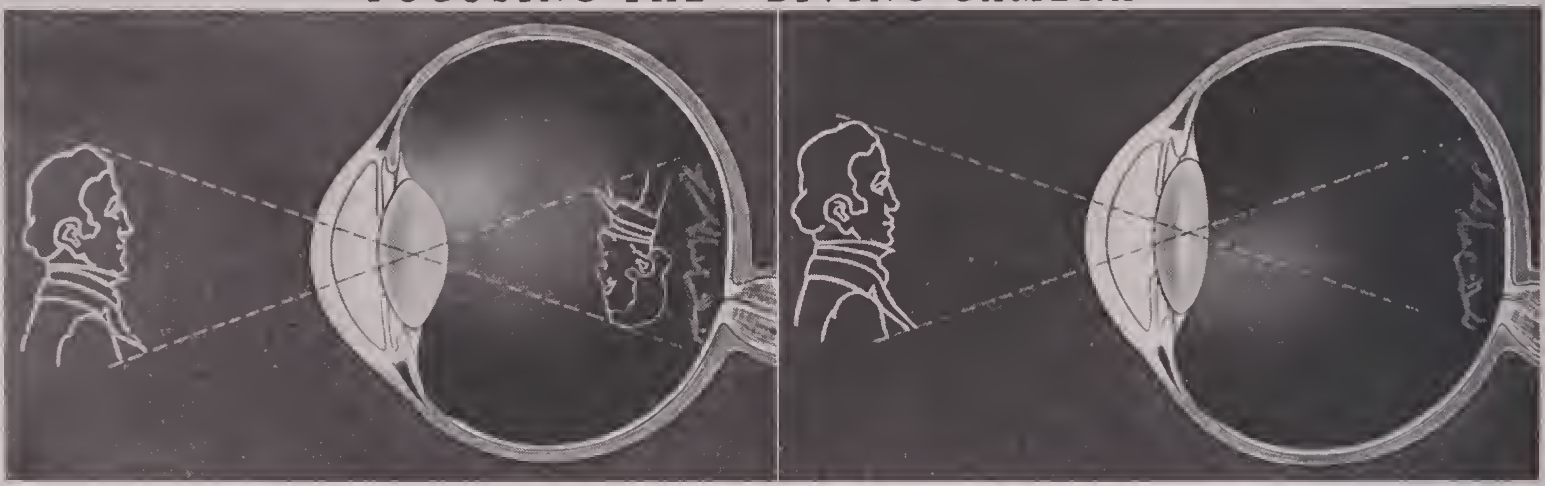
We read in bed and strain the muscles; we read with a glaring light, or a poor light on the printed page; with the light directed into our eyes instead of on the printed page; we read on the rapidly moving car and

SEVERAL WAYS OF LOOKING AT THE WORLD!



(1) Eye of Solitary Frog; (2) "stalk eye" of Crab; (3) eye of the Toad; (4) Whirligig Beetle; (5) the Chameleon's eye; (6) eyes of the Snail on stalks; (7) Cat's eye; (8) Moth's eye; (9) eye of the Dog; (10) Spider eyes; (11) Eagle's eye; (12) Grasshopper's eye; (13) Sheep's eye; (14) eye of the Fly; (15) the Cow's eye. Nos. 4, 8, 12, and 14 are compound eyes.

FOCUSING THE "LIVING CAMERA"



In cameras the lenses must be moved forward and backward to get exact focus alike on near and distant objects. The lens in the "human camera" cannot be moved, but the eye accomplishes the same result by changing the curvature of the lens. In the picture on the left the eye is in normal position, and if unchanged would focus the image too far in front of the retina. The muscles attached to the lens flatten it, however, and thereby the image is thrown back upon the retina.

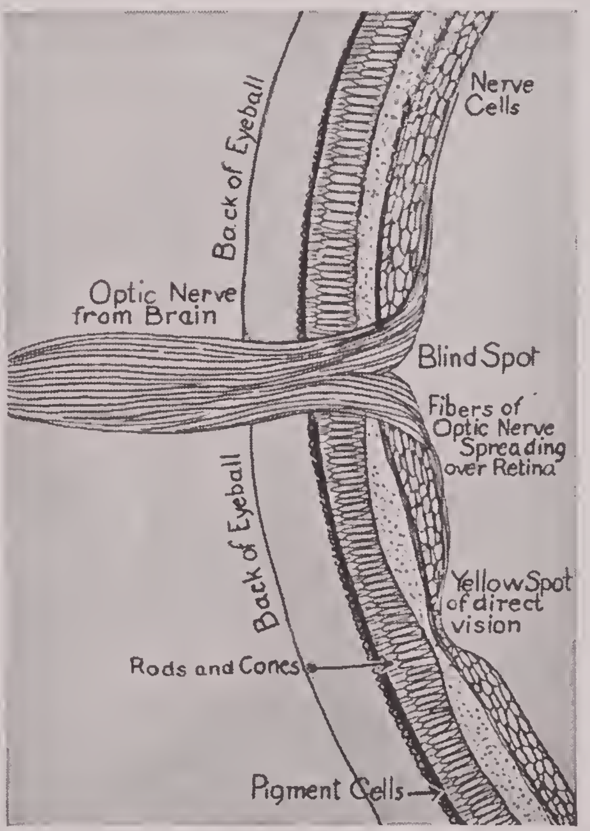
thus overwork the focusing muscles; or for too long a time, paying no attention to the fact that our eyes are uncomfortable.

We read when we are sick, or perhaps when we have got something in the eye and have neglected to go to the oculist to have it removed. Perhaps we get careless and wipe our eyes on a public towel in a public washroom; or rub our eyes with unclean hands or a soiled handkerchief; thus introducing disease into the eye.

An eye which is throwing off pus (commonly known as "mattering") is a dangerous eye, both to its owner and to others, and it should be looked after by a competent oculist at once. The proper fitting of glasses is very important, especially in the young. Never get glasses from a street vender or untrained optician. A competent oculist should always be consulted even when the warning seems trivial.

This organ of sight is too delicate a piece of machinery, and our happiness depends in too large a measure upon it, for us to neglect it. When we destroy a camera, we can buy a new one; but the wealth of all the world cannot replace an eye that is destroyed or has become permanently blind. Artificial eyes of glass are now made which so marvelously imitate the real ones that the difference can scarcely be detected. But they lack, of course, the chief quality of an eye—you cannot see with them.

"PHOTOGRAPHIC PLATE" OF THE EYE



The retina, which registers the image focused by the lens, may be looked upon as the outspread network around the inside of the eyeball, formed by the branching fibers of the optic nerve. The inner layer is transparent, and the light passes through this to the "rods and cones," which form the real "sensitive plate" of the eye.

There are a certain number of people in every hundred whose eyes seem to be perfect except in color seeing. According to one experimenter's figures, one person out of every 55 cannot tell red from green, and one in 50 confuses brown and green. Pink and yellow look alike to some people, and blue and green to others. A very few persons can distinguish only light and shade, seeing everything as black and white. The cause of color blindness is thought to lie in the nerve fibers in the retina. It is sometimes called "Daltonism" from a famous English chemist who in 1794 described his own case.

In some cases there may be a total absence or paralysis of the nerve fibers sensitive to a certain color. But in a great many cases it appears that a defective color sense can be improved by proper education, just as the senses of form, size, and distance can be educated. Perhaps you have wondered why brightly colored cards, pegs, wools, crayons, and paper weaving-mats are used by the children in kindergartens, and in the lower grades in school. It is because teachers find little children as clumsy with their eyes as with their fingers, and take this way to train them.

Women see colors better than men, as a rule. Their interest in dress, house furnishings, and flowers make them more familiar with colors. Yet there are men silk dyers who can grade 60 shades of gray.

F

FABRE (*fä'br*), **JEAN-HENRI** (1823–1915). At dusk the French peasants peered over the hedge and gazed pityingly at the old man seated on a stone watching a wasp's nest. "He has been there since dawn," they whispered as they went on their way, tapping their foreheads significantly. "Poor innocent!"

THE NATURALIST AND THE PHILOSOPHER

Fabre, the "Homer of the Insect," was a student of things rather than of books, while John Stuart Mill, the eminent English philosopher and political economist, was a broad-minded man of books—knew the Greek alphabet at the age of three and at eight read Xenophon and Plato. But there was a strong feeling of sympathy between the keen-eyed Frenchman and the meditative Englishman, who are here shown together on a hillside near Fabre's home in France, looking at a butterfly.

Henri Fabre, the object of their pity, did not hear them, did not stir. For the wasp nest to this great French naturalist was a wonderful geometrical home with a modern stucco front; with portico, vestibule, galleries, nurseries, spacious dining rooms and well-stocked pantries; with decorative twisted cords here and there looking like delicate gold lace—it was a setting for certain tiny creatures who revealed to him the secret of their acts, the mystery of their lives, of their food and battles, of their loves, and even of their death.

From the time he was five years old and was trying to find out how the cricket chirped, Fabre was greatly interested in the tiny insect guests of plants and brambles, stones and sands. But born of humble illiterate parents, he early had to struggle with poverty, and was so busy peddling lemons on the market place, working with a gang of railway laborers, and in between times studying hard at school, that he had but little time to give to the world of nature he loved so well. When he was 19 he left the College of Rodez and took charge of a primary school at Carpentras, receiving a salary of only $140 a year. His very first month's salary was spent in buying a book on insects, and, as he afterwards put it, "While I turned the pages for the hundredth time a voice whispered vaguely, 'Thou, too, shalt be a historian of animals.' "

Fabre married early and soon had a large family to support with the small salary received as Professor of Natural Philosophy at the College of Ajaccio in Corsica, and later at the Lycée of Avignon in southern France. His was a long life of great poverty, sacrifice, struggle, and superb perseverance, his principal works being published between the years 1862 and 1880.

At last, after 40 years of unceasing toil, he retired to a humble home in Sérignan, Vaucluse, where he could give himself without reserve to his insects' paradise. Here he remained for the rest of his life contemptuous of riches, indifferent to worldly honors, sacrificing everything to his work, and gaining a knowledge of insects unequaled by any other naturalist. Until nearly 80 years old he was almost unknown to the world. Then the poet Mistral interested some scientists in him and rescued "the Insect's Homer" from poverty and obscurity. His greatest work, 'Souvenirs entomologiques', was finally crowned by the French Academy and five years before his death the French government granted him a pension.

During his long life this great naturalist, the friend of scientists and little children, whom Darwin called "a savant who thinks like a philosopher and writes like a poet," wrote many books, enthusiastic records of his patient observations. He poked into the private lives of "Bugland" citizens and revealed what he saw in stories curious, quaint, happy, or tragic, as charming as fairy tales. How delightful they are, these tales of the spider who begins his career in a tiny flying-machine; of the praying mantis whose frightful aspect deprives its victim of the power to move; of the wasp who has David and Goliath-like battles with the caterpillar; and of the tarantula in her donjon tower lying in wait for her prey, her eight eyes gleaming in the dusk! And Jean-Henri Fabre records these tales with a touch of mystery, knowing that life even in the insect world obeys and reveals the supreme law.

Among Fabre's principal works as translated into English are: 'Social Life in the Insect World' (1912); 'The Life of the Spider' (1913); 'The Life of the Fly' (1913); 'Bramble-Bees and Others' (1915); 'The Life of the Grasshopper' (1917); 'Our Humble Helpers' (1918); 'The Wonders of Instinct' (1918), and 'The Mason Wasps' (1919).

FACTORIES AND FACTORY LAWS. A billion slaves toiling every day from sunrise to sunset, but using the spinning-wheels and hand-looms of 200 years ago, could not make as much cloth in a year as is turned out in a week in the great cloth factories of today. This is the estimate which a careful historian gives of the enormous increase in man's productive power through the invention of machinery and the organization of the present-day factory system of manufacturing.

In the articles on Spinning and Weaving, on the Industrial Revolution, and in the sketches of the inventors,—James Hargreaves, Richard Arkwright, Samuel Crompton, Edmund Cartwright, James Watt, and others—you may read of the first steps in 18th century England which brought about this tremendous revolution. Manufacturing now is no longer carried on by workmen in their own homes, who use their own tools and raw materials, work when and how they please, and have their little plots of ground from which to supplement the earnings of their trade. In place of the simple hand tools such as had been used for hundreds or thousands of years, they now use vast and complicated machines, housed in giant factories and driven by water-power, steam-power, or electricity. Instead of a single workman making an entire pair of shoes, the process is so subdivided that 250 persons have part in its production. The machines, buildings, and material moreover belong to some person or group of persons who supply the money or "capital," the business is conducted by executives who have the skill necessary to make the enterprise profitable, and the workmen are merely employees, dependent usually for their sole support upon the "wages" which they receive.

The English at first jealously guarded the secrets of their inventions. Machines were not allowed to be shipped from England, and even sending plans abroad was forbidden. For this and other reasons, the factory system developed later in other countries, including the United States, than in Great Britain. But in 1790 Samuel Slater, a young English workman, came to America and from memory drew the plans for and superintended the setting-up of a cotton mill in Rhode Island (*see* Rhode Island). It was not until 30 years later that the factory system began to develop in France, Germany, and other countries of continental Europe.

As a result of the factory system, prices of all manufactured articles have dropped and conditions of life have improved. The worker has shared to some extent in this betterment. His food and clothing are better, opportunities for education are wider, chances for advancement are more numerous.

At first, however, the factory caused much suffering among the laboring class. Its untiring swiftly moving machinery did away with the need for a host of workers. Moreover, since women and children could operate the machines as well as or better than men, and their labor could be obtained for less wages, thousands of men were thrown out of employment and wages became pitifully small. Working hours were frightfully long. Children as young as five and six toiled from 10 to 15 hours a day; women worked from 12 to 16, and men up to 18, hours a day. Factory work also was monotonous and depressing, and the conditions under which it was carried on were usually unhealthful. Men became nervous, diseased, and vicious. Babies of factory women, lacking care, died in alarming numbers. The little children who were employed in factories were pale and sickly, and if they survived, grew into nervous, stunted, depraved men and women, who were dangerous elements in the national life.

But such conditions could not last. In 1833 the employment in factories of children under nine years of age was prohibited by the British Parliament. The hours of older children were greatly shortened, and provision was made that all children under 13 should attend school at least two hours a day. Other British laws were passed limiting the working hours, improving sanitation, providing for safety devices on dangerous machinery, prohibiting night work for children and all work in mines for both women and children, and establishing minimum wages.

If the factory system and its evils first arose in Great Britain, it should not be forgotten that the legislation to remedy these evils began there also. In other countries, including the United States, similar laws have been enacted, and in almost all factories today working conditions have greatly improved over former years. Only in far-off Japan, and other countries where the factory system was late in coming, do the conditions now resemble the terrible ones which prevailed in England at the beginning of the 19th century (*see* Child Labor Laws).

FAIRIES. "Do you believe in fairies?" asks Peter Pan of the audience at the close of Barrie's charming play. In the faces of young and old there is the same answer, for so real do the fairies seem that for the moment we all believe in them. If we can almost believe in fairies today we need not wonder that people of earlier times, who did not have science to explain the strange and wonderful things of the world, felt so certain of the existence of such supernatural beings.

Fairies were supposed to be of almost any size or appearance, and many of them had the power to transform themselves into the shapes of animals. Most often imagination pictured them with the form of human beings, but very, very small—"a few inches high, airy and almost transparent in body; so delicate in their form that a dew-drop, when they chance to dance on it, trembles, indeed, but never breaks."

Related to the fairies are the *gnomes* or *kobolds*, ugly little creatures who live underground and guard the earth's stores of jewels and precious metals; the frolicsome *elves;* the *brownies*, who love mischief but will perform many helpful tasks for the family that is kind to them; the *kelpies* and *nixies*, who are water fairies and lure men to their death in the depths of beautiful streams; and the *trolls*, who are familiar and friendly, but often mischievous dwarfs. There are good fairies and bad fairies, but most of these little people are kind to those who do right and who are good to them, and punish those who are wicked or who offend them.

We find fairies in the folklore of almost all peoples. Some of the most beautiful and fanciful of our fairy tales come from Ireland, and in many parts of that land the country folk still believe in "the good people," as they call these little sprites. In English folklore Oberon is represented as the king of the fairies, and Titania as their queen.

FAIRS AND MARKETS. When a nobleman of the 13th century needed a new sword or lance, or his lady a new gown of state, or his peasants a plowshare or other tool, where did they get them? Towns were far apart, and usually contained only a few small shops in which merchants displayed the wares made by their journeymen and apprentices in their own workrooms. So both nobles and peasants would usually wait to supply their varied needs until the time of one of the great annual fairs, held in certain privileged cities commonly at the time of a great church festival. Then, on foot and on horseback, they hurried to the town, to gaze in wonder at the marvelous goods from far and near displayed in the booths, and to buy such of them as they needed or fancied and their purses would allow.

But what a different aspect the town wore at such a time from its ordinary appearance! The narrow streets were lined with wooden booths and stalls, or perhaps a special inclosure was set aside for the fair at the city's gates. Here were woolen cloths from Flanders, and there costly spices from the East, with silks and velvets of wondrous hues. From Gascony came wine, from Norway tar, and from Germany furs and amber. Here was the street of the goldsmiths, and there those of armor-smiths, weapon-makers, saddlers, and the like. In a certain stall could be purchased the sacred relics so much valued for warding off disease. And at the end of the street, on raised platforms, jugglers and tumblers performed their feats of skill, the puppets of a Punch and Judy show drew about them crowds of admiring beholders, and ballad singers sang their lays. Everywhere crippled or blind beggars reaped their harvest of coins from spectators and bystanders.

The lord whose right it was to hold the fair levied fees and tolls upon the merchants, in return for which various privileges were granted them. Disputes were settled summarily by the "Court of Piepowder" (French, *pied poudreaux*, meaning "dusty foot"). Quick justice was dealt out not only to all who broke their agreements but also to those who cheated their customers—such, for instance, as the man caught selling a ring of brass for one of "purest gold that he and a one-eyed man found on the last Sunday in the Church of St. Ives near the Cross."

For a week or two the buying and selling, the dancing, the gambling, and the amusements in general continued. Then the merchants packed up their wares, and with a motley vagabond train of all nationalities moved on to another fair. The peasant, with wife and children, trudged home with their purchases; and the knight and lady rode home with falcons on their wrists, their spices and silks carried by their faithful attendants, to take up again the dull life of their castle.

The right to hold such a fair was one of the most highly prized privileges in the Middle Ages, and it was one which could be obtained only by a charter from the king or other lord. Among the most famous fairs were those of St. Bartholomew at Smithfield (just outside of London), the Leipzig fair in Germany, and that of Troyes in France. From the weights used at the latter we get our system of "Troy" weights, and from the laws and customs in force at these fairs we get the beginnings of our system of commercial law.

To many towns which did not have a fair, and also to some which did, was granted the privilege of holding a market on a certain day of the week. Here were sold humespun linens and cloths from the local weavers, as well as the squawking geese, cackling hens, squealing pigs, and wheat and rye brought by the peasants from nearby villages. In many respects it reminds us of the markets you may see in many of our cities today, to which farmers bring their produce on a set day or days of the week.

The medieval fair survives in some sections where commerce is still primitive, as in the interior of Asia; and in Russia where the great fair of Nizhni Novgorod in quite recent times has been attended by 100,000 persons, from all parts of Asia and Eastern

Europe. But in Europe generally the fair has become specialized, and in place of all sorts of commodities we find only one or at most a few kinds offered for sale. Thus the fair at Leipzig is now devoted entirely to books; that at Ipswich, England, to cheese; while others are for horses, cattle, sheep, pigs, etc., as the case may be.

In the state and county fairs of the United States, almost the only resemblance to the medieval fair is to be found in the amusements—the wild men, the fat women, and other side shows. The world's fairs likewise present few features in common with those of the 13th century, for these are exhibits of the industries of the world and the progress of invention, and not places for buying and selling. Many such world's fairs or international expositions have been held since the first took place in the great Crystal Palace Exhibition at London, in 1851. In America the most important have been the Centennial Exposition at Philadelphia in 1876, the Columbian Exposition at Chicago in 1893, the Pan-American Exposition at Buffalo in 1901, the Louisiana Purchase Exposition at St. Louis in 1904, the Lewis and Clark Exposition at Portland, Ore., in 1905, and the Panama-Pacific Expositions at San Francisco and San Diego in 1915.

FALCONRY (*fa̤'kn-ry*). To vary the monotony of life in their castles, the lords and ladies of the Middle Ages would often ride forth with their attendants to enjoy the courtly sport of hunting with the fierce swift falcons. With the "hooded" birds on their gloved wrists, they sought the haunts of wild ducks, cranes, herons, and other winged game. When the quarry was sighted, the falcon's hood was slipped and it was thrown into the air. Like an arrow, it darted after its victim, plunging its talons into it and crouching over it until the hunters galloped up. The "peregrine falcon" or duck-hawk was the favorite bird of the falconer (*see* Hawk).

But falconry or "hawking" dates far back beyond the Middle Ages. Carvings in the ruins of ancient Babylon indicate that it was practiced in Mesopotamia at least as long ago as 1700 B.C., and it was probably more ancient than that in China. It is still practiced in many parts of Asia, the golden eagle taking the place of the falcon in some districts. Antelopes, foxes, wolves, as well as smaller game are taken with the aid of these trained eagles.

HUNTING WITH THE FALCON IN ENGLAND

No sport, not even fox hunting, was ever more popular in England than hunting with the falcon. It was followed from the eleventh century, when it was introduced by the Normans from the Continent, to the middle of the seventeenth century. In this picture the lord and lady have just sighted the game and unhooded the falcon, which is carried to the chase on the gloved hand. There are many references in Shakespeare to this sport. The training and flying of the various kinds of hawks used, from the long-winged gyrfalcons and peregrines to the short-winged kestrel and goshawk, was an elaborate art with a terminology and etiquette all its own. Falcons are still flown to some extent in Egypt and other countries in hunting game birds and other small animals.

LITTLE TALKS ON GREAT THINGS

by Arthur Mee

FAITH

PESSIMISM is despair; the pessimist is the man who looks out on the world without hope, seeing gloom in everything, and believing the worst. We should guard ourselves against this always, for nothing is more certain than that the world moves on toward good.

The world has always laughed at the dreamers who make things come true. In every age there are those who dream and those who laugh, and when the age has passed away another age comes on; and always it is true that when the world looks back it puts up statues to those who dreamed and laughs at those who laughed.

Let them laugh! Let us rather be numbered with those who believe their eyes than with the old farmer at the circus who stared at a giraffe with eyes wide open, and at last exclaimed, "There isn't such an animal!" Let us rather believe in heroes than in scoundrels, in wise men than in fools. Think of the men who would not believe, and the things they would not believe. The corridors of the centuries ring with the mockery of those men who were deaf and blind to things beyond their little understandings.

Let us be careful before we say that dreams will not come true. Shakespeare did not believe in telegraphs, but he did not laugh at the thought of them, for he believed that there are "more things in heaven and in earth than were dreamed of" by the wisest men alive. And it is always so. "War is only just beginning," says the pessimist; but he forgets that war has always been, and that peace has never yet begun. Only a lunatic believes that a world of sane men can find no way to live on this beautiful earth except by killing one another. Let us put the pessimist in his proper place. He belongs to the family of the old farmer who would not believe in the giraffe, and they both have distinguished ancestors.

They were there, these unbelieving people, when poor Richard Trevithick, in 1802, was driving his strange old smoking sparking steam carriage through the country lanes at midnight; they laughed to scorn this man who had the beginning of railways and automobiles in his brain. James Watt's aunt was of this ancient family. She would watch the boy sitting by the fire, and would say: "James Watt, I never saw such an idle boy. For the last hour you have not spoken one word, but taken the lid off that kettle and put it on again, catching drops of water from the spout. Are you not ashamed of spending your time like that?" And then there were the clever men who knew so much better than George Stephenson. They went in a great procession into the witness-box and proved how his locomotive would burst the boilers and blow the passengers to bits; how the fumes from the chimneys would destroy the crops and stop the cattle from grazing and the hens from laying; how the sparks would burn the houses down, and how the countryside would be turned into a wilderness by this knave who talked of riding in trains.

Even if all these things did not happen, those clever people said, it was quite impossible that the wheels of a train would grip the rails; they were as sure about it as the ex-president of the Royal Society was sure that steamships were impossible. Nobody believed in those mad dreams of inventors that were changing the face of the earth. Nobody believed in Robert Fulton when, during a prolonged residence in Europe, he proposed to build his first steamboat; if they had believed in him the whole history of our times would have been vastly changed.

Not even science has always had faith in itself. There was a great day at the British Association when a young man from Manchester began to talk about the power of heat, but the scientists were bored, and the president called him to order. Today all the world honors that young man and knows that he was announcing one of the greatest discoveries in modern science. He was James Joule.

If science has at times been so hopelessly wrong, we need not be surprised at the stupid things the politicians say and do. You will find in the records of the British Parliament that a prime minister once said of the Suez Canal: "It shall not be made, it cannot be made, but if it were made it would bring war between England and France." The government did not want this great quickening-up of communications, but all great reforms have come in spite of governments. The men who should lead the nation, taking advantage of every stride forward and of every new field of knowledge opening up, have always stood in the way. A man once went to the British government with the telegraph, and was sent away with a sort of "No telegraphs wanted today." The British Post Office did not want the penny post; the secretary warned Parliament that the penny post of Rowland Hill would burst their walls!

Nobody believed in flying. Professor Langley, of the Smithsonian Institution, the man who first proved that flying was possible, was laughed at and jeered at until he gave up his work, a broken man. Wherever we look, whatever we think of, the pessimist is there. The truth is that the world is too wonderful to believe. The things we see about us are hard to believe for the man who knows something about them. It is hard to believe that the world has evolved from a mighty ocean of gas, or from scattered meteoric dust flying through boundless space. It is hard to believe that it was once a barren rock with not a living thing upon it. It is hard to believe that man has done the things he has done; that this little man, like a speck on the earth, has conquered the beast and magnified his senses so that his eyes can see a thousand times farther than Nature made them to see, his ears can hear a thousand times farther than Nature made them to hear, his voice can carry across the earth.

Life *is* hard to believe; a beehive is hard to believe, and the defensive fortress the trap-door spider makes. A seed is hard to believe, and all the beauty that grows out of it. It is hard to believe that a child could grow up to be William Lloyd Garrison, that he made up his mind to kill the great Goliath of Slavery, that he faced a whole continent alone, and that at last he won.

Of course, it is hard to believe. There are many things beyond our understanding, but we know the way we came, we know the way we go, and the rock on which our feet are set is not to be laughed into dust. Let them laugh who will, but as for us, let us believe. War has its night, but Peace will have its day, and man, who has come so far, who has come from the depths and conquered all his foes, will march to victories greater yet, and make this world the very Gate of Heaven.

FAITH

Say not the struggle nought availeth,
The labour and the wounds are vain,
The enemy faints not, nor faileth,
And as things have been they remain.

If hopes were dupes, fears may be liars;
It may be, in yon smoke concealed,
Your comrades chase e'en now the fliers,
And, but for you, possess the field.

For while the tired waves, vainly breaking,
Seem here no painful inch to gain,
Far back, through creeks and inlets making,
Comes silent, flooding in, the main.

And not by eastern windows only,
When daylight comes, comes in the light,
In front, the sun climbs slow, how slowly,
But westward, look, the land is bright.

—Arthur Hugh Clough.

FALKLAND ISLANDS. Three hundred miles east of Magellan Strait, near the tip of South America, lie the Falkland Islands—low, rocky, treeless, swept by fierce winds, and pelted three-fourths of the year by cold drizzling rains. The full force of the South Atlantic Ocean hammers their ragged coast line, and above the roaring breakers clouds of sea-birds whirl and scream.

Of the hundred or more islands in the group, only two are important—East Falkland and West Falkland, the former 95 miles long and 40 miles wide, the latter slightly smaller. On the eastern island is the town of Stanley, the southernmost outpost of the British imperial government. From here are administered the affairs of the whaling colony of South Georgia, 900 miles to the southeast, and of the South Shetlands, South Orkneys, and Graham's Land, far to the south in the Antarctic Ocean.

Forbidding as they are in appearance, the Falkland Islands form a highly prosperous colony. Large flocks of sheep thrive, whaling yields considerable profits, and the shipyards ply a lucrative trade in refitting vessels which have been battered by the storms in rounding Cape Horn. Monthly steamers call from England, and there is cable connection with Montevideo, Uruguay.

Discovered in 1592, the islands were owned first by France, then by Spain, and finally were acquired by Great Britain in 1771. On Dec. 8, 1914, a squadron of German warships under Admiral von Spee was overtaken and destroyed off the Falklands by British men-of-war. Population, about 3,000.

FALL RIVER, MASS. For many Americans the city of Fall River represents simply an incident in one of the pleasantest ways of getting from New York to Boston. When the traveler leaves his steamer berth at daybreak and with the sleep scarcely out of his eyes settles down in the railway train for his 49-mile ride northward to Boston, he perhaps does not realize that he has touched the outskirts of the third largest city of Massachusetts and the greatest "mill town" in America.

Fall River alone produces more textiles than any whole state except Massachusetts. Nearly 150 textile mills, with 40,000 operatives, weave each day enough cloth—mostly cottons—to reach from New York to Panama. The rapid growth in industry is due to an unusual combination of water-power and transportation facilities. The little stream of Fall River once furnished the power that turned the spindles of the long rows of cotton mills that line its banks. And now that the mills are run by steam, Mount Hope Bay, a harbor commodious for the largest ships, gives them Pennsylvania coal direct from Hampton Roads, as well as admitting the raw cotton from southern plantations. Besides cotton, Fall River produces foundry and machine shop products, silk, jewelry, men's hats, fur goods, pianos, knit goods, clothing, trunks, yarn, thread, and many other products. Granite-quarrying is also a principal industry and the city is largely built of the stone that underlies it.

Like the other industrial communities of Massachusetts, Fall River contains many foreigners. One-half the population is foreign born and eight out of nine are of foreign parentage, chiefly French Canadians, with a smaller proportion of English, Irish, Portuguese, Scotch, and Russians.

Fall River was originally settled by grantees of the Plymouth colony on land obtained by treaty with Massasoit, and still retains its Indian reservation. In 1843 it was destroyed by fire. Population, about 120,000.

FAMILY. The family in its simplest form consists of father, mother, and children. It is the most important of human organizations, the germ of all other social units, the most active influence in civilization, and the origin and nucleus of all existing governments. The very word "patriotism" is derived from the Latin *pater* (father), the head of the family, and it seems literally the love of your fatherland.

The thing which distinguishes the most primitive savages from other groups of mankind is the absence among them of close family ties. It was not until human beings formed into family units that they started to become civilized.

We may picture the growth of the family idea through the instinctive love of parents for their children. The helplessness of a baby probably inspired the first crude builder who fitted up a cave or built a shelter, and so created the first home. When the father gazed at his young son and saw a small image of himself, the desire awoke to make him a mighty hunter and fighter who would be a credit to the family name. Family pride arose, and parents toiled and accumulated property so their children should inherit wealth and power. We may imagine the head of the family gathering his children and grandchildren about him and telling his hunting experiences and his deeds of valor against his enemies; teaching them out of his long experience the dangers to be avoided, the tricks of beasts and men; showing them how to fashion weapons and how to cure fevers. Thus arose family customs and traditions, and out of these traditions grew the first records of history.

Gradually the family circle grew wider to include the slaves and other dependents. The father was the absolute ruler and his eldest son inherited his power. He held sway over his younger brothers and all their children, grandchildren, and dependents. In this way the *tribal* or *patriarchal* system grew up, in which the head of the oldest and most powerful family became the chief of the tribe, all of whose members were linked together by blood kinship or by adoption.

When neighboring tribes or villages were conquered, the descendant of the chief became the king, and the members of his house formed the nobility, as in the case of the Roman patricians. Often civil war would break out and part of the nation would split off into a separate government, ruled by a younger branch of the family. Many a nation today owes its independence to a family quarrel among its rulers.

The Old Testament provides the best example of the growth of a family into a great race. The sons of Jacob founded the 12 tribes of Israel, and from them are descended the Jewish people.

Family groups of the patriarchal type are often called *clans*. Examples are the clans of Scotland and Ireland, and similar groups existed in ancient Greece and Rome. The clan was perhaps a wider extension of the family idea, because men who had no kinship of blood could be adopted into it. All the members of a clan were bound to fight for their chief, whenever called upon. This is one of the earlier forms of the tie which binds together the members of nations today —the tie of military allegiance, which compels each man to fight at the call of his country. Clans have ceased to exist in Scotland and Ireland as organized groups, but the traditions of the clan system are still kept alive in the Highland festival customs and dress.

Families in all highly civilized countries today are formed by monogamous marriages—that is, the marriage of one man and one woman. But *monogamy* is by no means the only form of marriage. We know that the patriarchs of Biblical times often had many wives, all of whom formed a part of the immediate family. This custom, called *polygamy*, persists in Oriental countries to this day. The custom of *polyandry*, under which one woman has many husbands, is far more rare, being found only in barbarous communities, particularly in those where, as in Lapland, Tibet, and other bare and isolated regions, the men tend to outnumber the women. (*See* Civilization.)

FARADAY, MICHAEL (1791–1867). The great scientist, Sir Humphry Davy, was once asked what he considered his greatest discovery. "Michael Faraday," was his answer. A later English writer of note has declared that Faraday's work "lives wherever a dynamo spins; it is in the airplane, the deep-sea cable, the lights that light the ways of the world, and wherever electricity serves our kind."

Michael Faraday was born of very humble parents in a London suburb. When a boy he was apprenticed to a bookbinder. He read eagerly any scientific books that he could find in the shop, and so attracted the attention of a Mr. Dance, one of the customers of the place. This man took him to hear Sir Humphry Davy lecture at the Royal Institution. Faraday took notes on the lecture, and was encouraged to send them to Sir Humphry Davy and to ask for a position. The great chemist was delighted with the notes and the letter, and made Faraday his assistant. From that time on Faraday's career was assured, and he rose to be the foremost physicist in England.

Faraday's experiments covered a vast field of inquiry. At first he followed out Sir Humphry Davy's experiments with electrolysis—a method of breaking up chemical compounds by running an electrical current through them while in solution. He thus found out how to make magnesium, a new substance. Later he spent a great deal of time and effort on magneto-electric induction. He discovered, says R. A. Gregory, that all he needed to do was to move a magnet very rapidly "near a coil of wire properly arranged" to obtain a supply of electricity. It was not an impressive experiment. A lady who saw him perform it during a lecture asked, "But, Professor Faraday, even if the effect you explained is obtained, what is the use of it?" "Madam," replied Faraday, "will you tell me the use of a new-born child?" This discovery, the child of Faraday's brain, became the basis for the making of all electrical power generated by dynamos. The street-car systems of our cities, and countless other applications of electricity, owe their existence to him. Faraday was also the author of several theories concerning the passage of electrical waves through the ether, which became the basis for Hertz's discoveries that made possible wireless telegraphy.

FARM LOAN BOARD. To enable the farmer to borrow money for longer periods than the 60 days for which banks usually make loans, and at more reasonable rates of interest, an act was passed in 1916 by the United States Congress creating a Federal Farm Loan Board and establishing farm loan banks in each of 12 districts into which the country is divided. The board consists of the Secretary of the Treasury and four farm loan commissioners appointed by the President. The government contributed an original operating capital of $9,000,000, with provisions for its automatic repayment.

Each bank makes loans based on first mortgages, the loans never exceeding 50 per cent of the value of the land plus 20 per cent of the value of permanent improvements. Loans are made for the most part through associations of farmers, each of which must have at least ten members. The members of each association must be applicants for loans totaling at least $20,000. The mortgages given to the bank by members of a farm loan association are guranteed by the association and are used by the federal land bank as security for bonds sold by it to investors.

In addition to the federal land banks, other institutions called joint stock land banks may be organized by private capital, under charters from the board.

FAR'RAGUT, DAVID GLASGOW (1801–1870). The ranks of vice-admiral, rear-admiral, and admiral of the United States Navy were created successively to reward the services and acknowledge the genius of this greatest of American naval heroes. The operations which resulted in the capture of New Orleans and Mobile are comparable only to those of Nelson at Copenhagen, in the battle of the Nile, and at Trafalgar. The exploits of Dewey at Manila Bay and of Admiral Togo in the Japan Sea were accomplished under such different conditions, due to modern inventions, as to place them in a class apart from the sea-fighting of even a generation ago.

Farragut was born on July 5, 1801, in a pioneer cabin near Knoxville, Tenn., of a Spanish-descended father and a Scotch mother. Owing to his father's friendship with Commodore Porter the boy was appointed midshipman before his tenth birthday. The United States Naval Academy was not established until 1845, so cadets were educated and trained at sea. In the War of 1812 Midshipman Farragut sailed with the *Essex* on her famous cruise to the South Pacific, took a prize ship into Santiago, Chile, at the age of 12, and conducted himself with coolness and courage in the terrific battle with two British frigates in which the *Essex* was sunk. Forty-five years of routine duty followed, on cruisers, on training ships, testing ordnance in the department at Washington, and in charge of the establishing of the naval station at Mare Island, San Francisco.

DAVID GLASGOW FARRAGUT
The Hero of Mobile Bay

When the Civil War came, Captain Farragut was in his 60th year. Although of southern birth, with a Virginian wife and home, he decided that his allegiance belonged to the nation. He was given command of the western Gulf blockading squadron with a superb fleet of heavy ships, gunboats, and mortar vessels, and ordered to open the mouth of the Mississippi by taking New Orleans. The way up the river was defended by two forts, between which stretched a heavy iron chain. Farragut's first great triumph was gained when he burst the iron chain, ran his fleet past the batteries of the forts, evaded an enemy fire-ship, sank the river defense fleet, and captured New Orleans.

For 16 months more he saw exciting service on the Mississippi, aiding materially in the taking of Vicksburg. So continuously was he under fire that he won the nickname of "Old Salamander." Then he was ordered to take Mobile, the last stronghold of the Confederates on the Gulf. The enemy used all his skill in preparing for the defense. The entrance to the bay was protected by Forts Gaines and Morgan, and the channels were filled with torpedoes. Nevertheless, within three hours after the first gun was fired in Farragut's attack, the Confederate flag was hauled down (Aug. 5, 1864). It was at the crisis of this battle, when the Union fleet was on the verge of defeat, that he uttered his famous saying: "Damn the torpedoes! Go ahead!"

This was the last active service of David Farragut. For three years he had served the Union at an age when most men think of retiring, and the strain was too great. He now asked to be relieved from active duty, and when his request was granted, he settled in New York City. Great celebrations were held in his honor, and for the six remaining years of his life Farragut enjoyed honors such as have been accorded to few Americans. It is said that he was such a master of detail that he could have taken the place and done the work of any man in his fleet. Honest, upright, religious, of tender sympathies, he inspired profound respect, enthusiasm, and personal affection.

FATES. Human destiny, according to the ancient Greeks, was controlled by three Fates: Clotho, the spinner of the thread of life; Lachesis, who determined the length of the thread; and Atropos, the inevitable, who cut the thread. They were represented sometimes as young maidens, but more often as old and hideous women. Neither gods nor men could escape from their fixed decrees.

FATS AND OILS. The familiar substances that we call fats and oils are of enormous importance both as food and for various industrial purposes. Their value was strikingly shown in the World War of 1914–18, when the lack of them contributed to the defeat of the Central Powers. Fats and oils are human fuel, producing more than twice as much energy as any other sort of food. As the populations of Germany and Austria were reduced to smaller and smaller rations of this sort of food, their endurance was correspondingly lowered and their "morale" was undermined.

Fats and oils consist chiefly or entirely of carbon, hydrogen, and oxygen. They all burn readily and are insoluble in water, but more or less soluble in alcohol or ether or both.

According to their origin oils are classified as animal, vegetable, and mineral. Mineral oils, of which petroleum is the chief, are obtained from the rocky structure of the earth, but most scientists today believe that they are of vegetable origin, being formed from prehistoric plants buried far below the surface of the earth. The name "mineral oils" is retained, however, for convenience (*see* Petroleum).

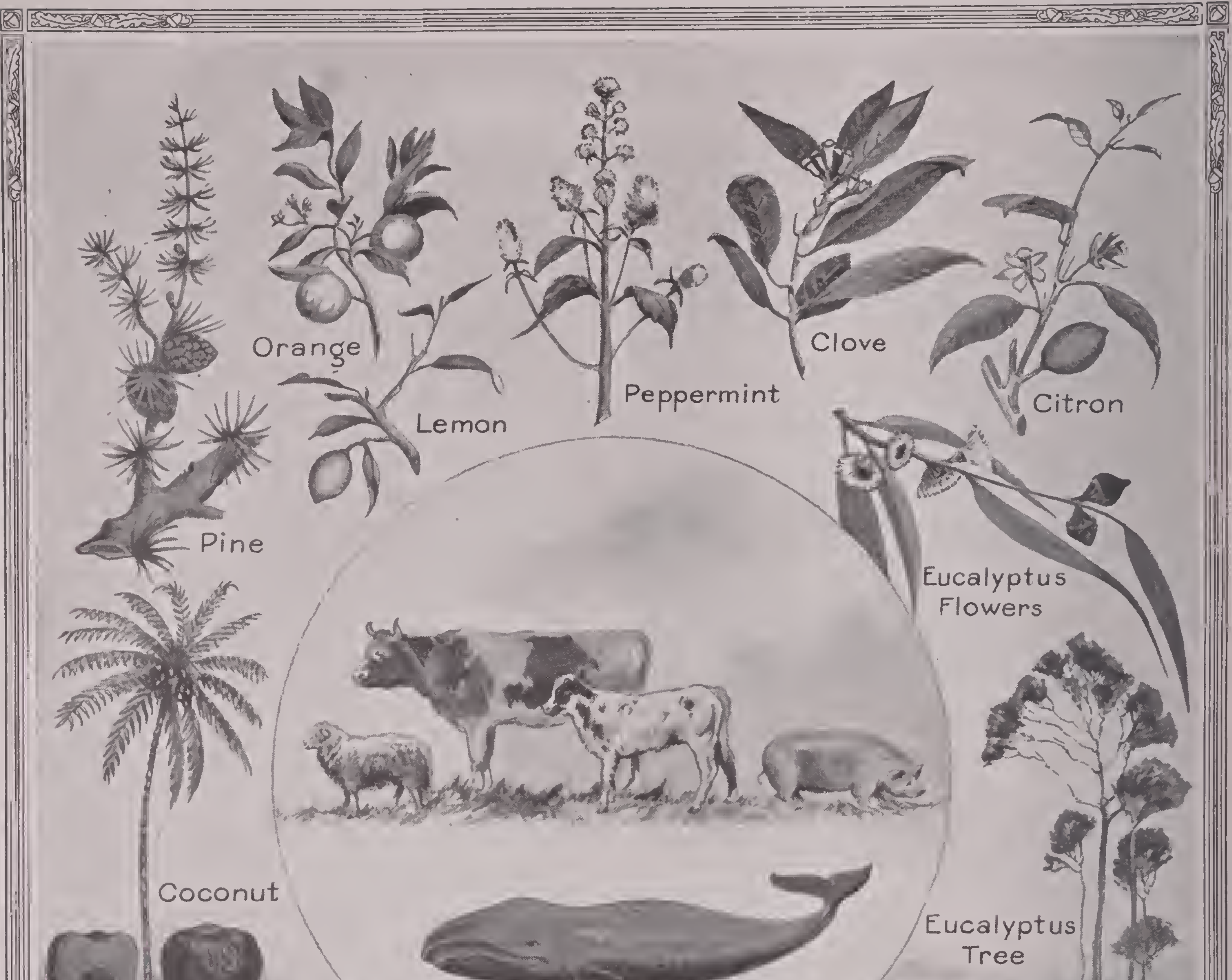
Difference between Fats and Oils

There is no sharp distinction between fats and oils, since the chemical composition of both is similar. For practical purposes we apply the term fats to substances that are solid at 68° F., and oils to those which liquefy at that temperature. All fats become fluid at comparatively low temperatures.

We also distinguish between "essential" oils, which evaporate rapidly and do not leave a permanent grease spot on paper, and "fixed" oils and fats, which leave permanent marks. The essential oils are all obtained from plants and are usually complex in their chemical constitution. They contain in highly concentrated form the characteristic odors of the plants from which they come, and hence are largely used for perfumes, flavorings, and in medicine. Elaborate processes, most of which require a long time, have been devised for their production (*see* Perfumes). Turpentine, which is chiefly used in making varnishes and paints, is one of the commonest of the essential oils. Others are the oils of lemon, clove, peppermint, spearmint, eucalyptus, cedar, and bitter almonds.

The fixed oils and fats are of both vegetable and animal origin. Butter, lard, tallow, neat's-foot oil,

IMPORTANT SOURCES OF FATS AND OILS



The central picture shows some of the chief sources of animal fats and oils—butter from the cow, tallow from the sheep, neat's foot oil from the feet of the cow and calf, lard from the hog, sperm oil from the whale, and cod liver oil from the codfish. Outside the circle are plants which give us valuable vegetable oils. Thus we get turpentine from pine trees for use in paints and varnishes, orange oil and lemon oil for perfumery, peppermint oil as a medicine and flavoring, oil of cloves as a medicine and perfume, citron oil for flavoring, eucalyptol from the eucalyptus for medical use, coconut oil for soap and other purposes, olive oil for food and medical use, cottonseed oil for food and soap, linseed oil from flax for paints, linoleum, etc., castor oil as a medicine and for lubricating purposes, almond oil as a medicine and perfume, and poppy oil as a basis for fine pigments. A map showing the various countries from which America gets its supply of vegetable oils would present nearly all the habitable regions of the world.

various fish oils, and whale oil are among the common animal oils. Lard, the most important of the fats with the possible exception of butter, is the melted and purified fat of hogs. It is much used in cooking, and in some countries it is eaten with bread. Tallow is melted sheep or cattle-fat. Before the days of kerosene, gas, and electricity, it was chiefly used for candles, but now nearly all of it is made into oleomargarine. The highest grade of tallow is called "oleo stock"; it is put into presses which separate it into "oleo oil" and the solid "oleo stearine." Both these products are used in making oleomargarine, and the oleo stearine is also used in the production of lard substitute and other products. Inferior grades of tallow and oleo oil are among the most important of the materials used in the soap-making industry (*see* Oleomargarine; Soap).

Vegetable oils come from a great many kinds of plant products. Chief among these are the olive, cottonseed, linseed, corn, soy-bean, almond, coconut, peanut, castor bean, and poppy-seed oils. Most of them are obtained by pressing the seeds or fruit in specially built presses, while most of the animal oils are "rendered," that is, extracted by heating in steam or water.

Those oils that have the property of rapidly taking up oxygen when exposed to the air and drying with a tough elastic surface are called "drying oils." They are of great importance in making paints and varnishes. Linseed oil, made from crushed flaxseed, is of great importance in oil painting, in the paint and varnish industry, and in making oilcloth and linoleum. Most of the American supply is grown and made at home. China wood-oil or tung oil, used for varnishes, is imported from China and Japan, where it is obtained from the nuts of various trees.

Non-drying oils take up oxygen much less readily and do not harden like the drying oils, but gradually decompose and become rancid when exposed to the air; olive oil is an example. These oils are chiefly used as food and in soap manufacture. The most important after olive oil is cottonseed-oil, of which the United States furnishes 70 per cent of the world's production. More than a billion pounds a year are used in making lard substitute, and large quantities are also used for salad and cooking oil, oleomargarine, and soap. Corn oil is another important food oil. It is a by-product of the manufacture of glucose and cornstarch, being pressed out of the tiny germ portion of the corn kernel. It is used in salad oil, other food products, and soap. Soy-bean oil is imported in large quantities from Korea and Manchuria to be used in making soaps and lard substitutes. Since it dries with greater ease than other oils of this class, it is also used as a partial substitute for linseed oil in paints and varnishes.

Coconut oil is important both as a food and in making soap. About one-half of the supply used in the United States is imported as oil and the rest is pressed from "copra," the dried coconut meat imported from the Philippines, Ceylon, and other points of the Far East. Peanut oil, used chiefly as a salad oil, comes for the most part from China and Manchuria. Olive oil, pressed from olives, is the best of all oils for salad oils and for soap-making, but comparatively little of it is used in the United States because of its high cost. Nearly all the supply is imported from France, Spain, and Italy, where the olives average twice to three times as much oil content as do California olives. Much of the oil sold as olive oil is adulterated with cottonseed and corn oils. Palm-kernel oil, which is much like coconut oil, is imported from Africa. It is used for food, for soap, and in making textiles. Castor oil, which is made from the castor bean, comes chiefly from India; small quantities are made in Cuba, Haiti, Hawaii, and other tropical territories, and in the United States. It is valuable in making fine lubricants, soap, and sticky fly-paper, and in medicine. It became particularly important in the World War as a lubricant for airplane engines.

When the oils are pressed from cotton, flax, and other seeds, the hulls are left in the form of hard oily cakes called *oil-cake*, which is ground into meal and used both as feed for animals and as fertilizer. Cottonseed meal, linseed meal, and castor-pomace are all rich in nitrogen and therefore exceedingly useful for both these purposes.

Chemically, oils and fats are mixtures composed chiefly of *olein*, *stearin*, and *palmitin*, which are compounds of glycerin with the fatty acids known respectively as *oleic*, *stearic*, and *palmitic* acids. In soap-making, oils and fats are boiled with alkaline solutions and the fatty acids combine with the alkalies to form soap, and the glycerin is separated as a by-product.

FAUST (*foust*) **LEGENDS.** In the early 16th century there sprang up, first in Germany and later in other countries in Europe, various tales of a magician, Dr. Johann Faust, who was in league with the devil, performed marvels with the aid of the evil one, and practiced the black art. There seems to be little doubt that a soothsayer of this name really existed (said to have died in 1538), but the facts of his life have been lost amid the legends which have crystallized about him. He was represented as a charlatan who traveled from place to place in Germany, living by his wits, and claiming to be a physician, alchemist, and astrologer, and a great magician.

Faust first appears in literature in the 'Historia von Dr. Johann Fausten', published at Frankfort in 1587, which contains most of the famous stories told of him. It relates how he sought to acquire supernatural knowledge and power by a compact with Satan. This pact, signed with the blood of Faust, set forth that Mephistopheles, a devil, was to become his servant for a period of 24 years, at the end of which Faust agreed to give himself up to Satan. Mephistopheles entertained his master with high living, long discussions on the relation of the devil towards God, the nature of heaven and hell, the eternity of punishment for sin, etc., and with glimpses of the spirit world. At the end of the 24 years, in the midst of an earthquake which shook his house, Faust was carried off by the devil.

The story gained wide popularity and was used as a theme by many writers. It became the subject of a great dramatic poem, 'The Tragical History of Doctor Faustus', by Christopher Marlowe, the father of English tragedy (1589). Strolling players introduced the play into Germany where it degenerated into puppet-plays and Punch and Judy shows, until Goethe at the opening of the 19th century raised it to quite another level.

There gradually crept into the Faust legends the shadowy figure of a beautiful young German girl, Gretchen, a daughter of the common people, with whom Faust fell desperately in love. This element of the story grew and grew in importance until in the hands of Goethe it blossomed into the charming personage of Margaret, whose betrayal by Faust is one of the dominant notes in Goethe's poetic tragedy 'Faust'. This is unquestionably the greatest treatment of the legend. Contrary to the early versions, Mephistopheles fails to absorb Faust completely in the pleasures he provides—one of the conditions of the compact in Goethe's poem—and the result is the ultimate salvation of the magician. Gounod's opera 'Faust', adapted from Goethe's tragedy, was first produced in Paris in 1859. Rembrandt was one of many artists who illustrated the legend.

FAWKES (*faks*), **GUY** (1570–1606). For more than 300 years the fifth of November has been celebrated in England by the burning of stuffed figures of this Gunpowder Plot conspirator (from which comes our phrase to "look like a guy"), while the children sing:

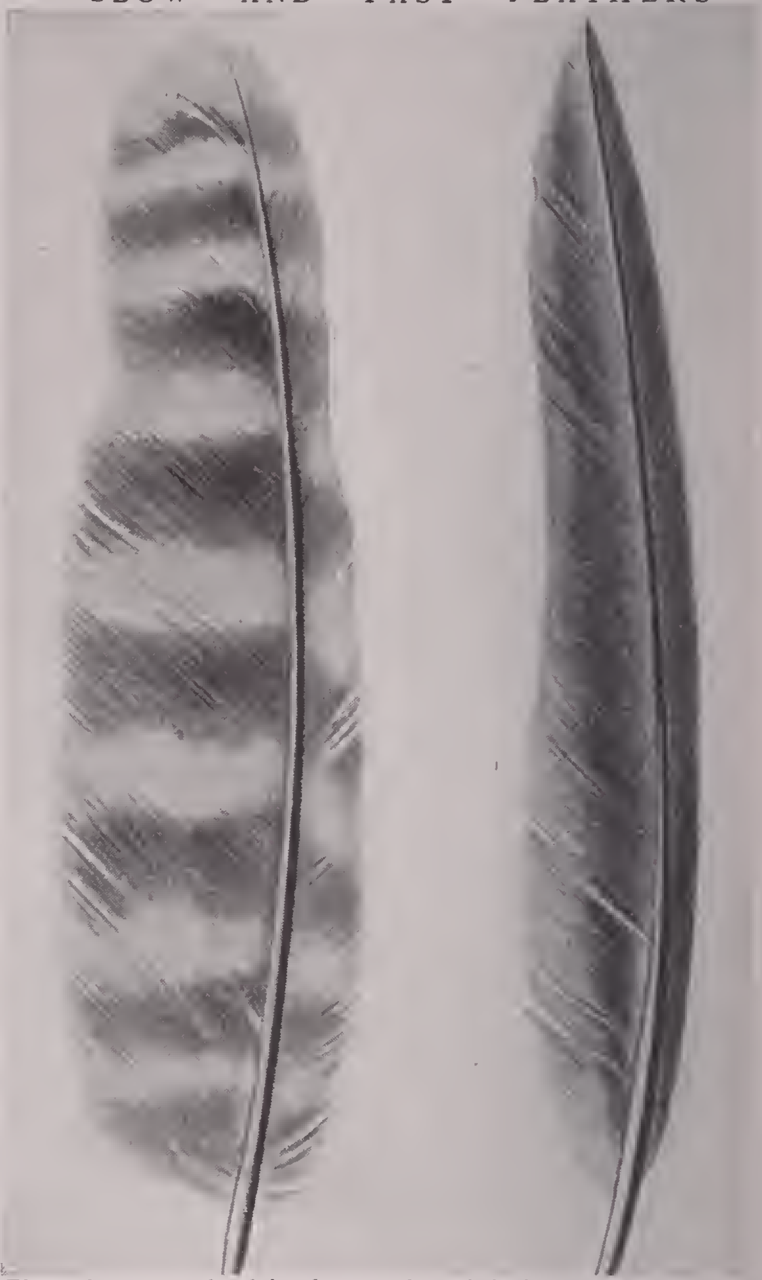
Remember, remember, the Fifth of November,
    Gunpowder, treason, and plot!
I see no reason why Gunpowder treason
    Should ever be forgot.

This old custom keeps alive the horror felt by England in 1605 when Guy Fawkes and his friends, because of Catholic discontent, tried to blow up King James I and Parliament. They succeeded in storing 30 barrels of gunpowder in a cellar under the Parliament House, but before Parliament opened, on November 5, the plot was discovered. Guy Fawkes and his helpers were executed.

FEATHERS. A feather is a horny product of the skin of birds, of which it is the distinctive characteristic. It arises from a nipple at the bottom of a pit in the skin that begins to form long before the embryo is hatched. Around this nipple there forms a cap of secreted horny material that presently becomes loosened and is pushed up by another cap forming beneath it. Thus a tube results, which is the shaft or "quill" of the feather, and in which the succession of "caps" may usually be seen. When the full size is reached the process ceases, the root end of the quill closes, and the feather is easily pushed out and discarded at molting time by the new growth.

These feather-making pits are not uniformly distributed over the body except in a few primitive remainders of extinct groups, such as the ostriches and penguins. In other species they are distributed in certain narrow tracts, differing in and characteristic of various systematic groups of birds; and in life the naked tracts are hidden by the overlapping "plumage," as the general coat of feathers is termed.

"SLOW" AND "FAST" FEATHERS



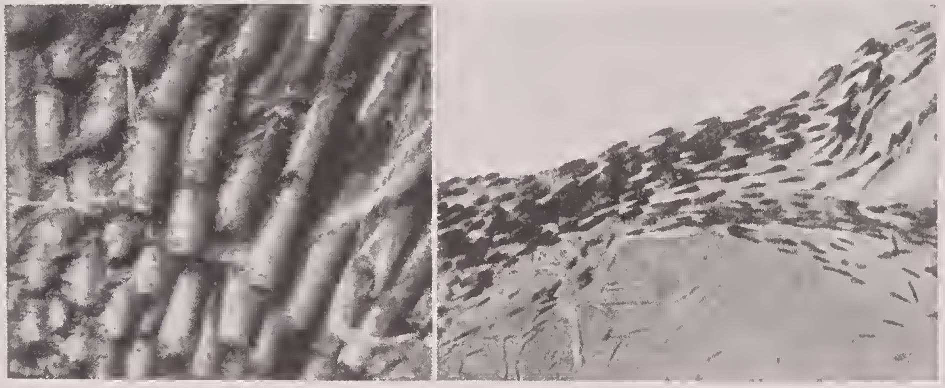
The soft, loose-edged feather on the left is from the owl. Because of its softness the owl's flight is slow and noiseless, which is more important to the owl than speed. Feathers "built for speed" are hard and trim, like the pigeon feather on the right.

This plumage is preceded in the nestling by one or more coats of small immature feathers ("down"), which are successively shed and replaced until the final mature coat is obtained. Even the mature feathers are not intended to be worn always. They become worn and torn (often causing thereby a seasonal change of coloring, as in bobolinks), and once, or in some cases twice, a year are shed, or "molted," and replaced by a new growth from the same sources. These molts may result in differences in color and form of plumage according to the season.

The Two Parts of a Feather

A feather consists of two parts, the "quill" and its horizontally branching growths that form the "vane" in various shapes. Sometimes these branches are disconnected, or nearly so, as in downs and in ostrich plumes; but ordinarily they carry branchlets, or "barbs," that hook together at their adjacent tips in a firm but elastic web, especially strong in the large "flight feathers" of the wings and tail. The vane may be nearly or quite absent from some feathers, as in the bristles about the mouth of flycatchers; or it may become solidified into scales, as in penguins. These variations in delicate structure are unlimited, and, together with its capacity for color, make a feather one of the most beautiful things in nature.

HOW FEATHERS GROW FROM SKIN



On the left we see how the stumps of the feather quills fit into the skin of the great bustard. At the right is a section of a song thrush's skin, greatly enlarged, with young feathers commencing to grow out of it. The black dots are the beginnings of the feathers.

The color of feathers may be due to contained pigments, or may result from mechanical conditions. The pigments are apparently waste products of the blood, and consist of black, red, yellow, and in some cases of a red or a green peculiar to certain families of birds. These may be generally diffused, or exist in combinations that give intermediate tints, or be modified by colorless structures in the feather, as in most blues; and so an infinity of hues and patterns is produced from a few color elements. White is the appearance resulting from innumerable air-spaces. Iridescent feathers, such as those on the neck of the "burnished" dove, or in the gorgets of humming-birds and the tail of the peacock, are prismatic in character—"that is, a blackish pigment may lie beneath the surface, which, whether polished, ridged, or pitted, acts as a series of prisms, causing the hue to vary according to the relative position of the spectator's eye and the light."

Why Feathers are So Much Better than Scales

Compared with scales, and to a less degree with hair, feathers form a warm covering. In this fact perhaps lies the secret of the success of the developing class of birds in the constantly cooling and drying climate, and change of conditions generally, that killed off the big leather-hided or scaly reptiles of the late Mesozoic days in which the class arose. The acquirement of feathers meant not only a lighter and more flexible covering than scales, but one that would retain the natural heat of the body (which amounts to something even in "cold-blooded" creatures), and would at the same time keep out the coldness of chilly air or water. The increase of warmth thus brought about meant a steady increase in warmth of blood (a bird now has a higher temperature than any other animal), and that tends to produce an enlargement of bodily activity and a stimulus to brain and life in every way. Added to this was the new power of flight, enabling a bird more easily to escape enemies and to flee from bad conditions to better ones, or seek food over a wide area. It is the acquirement of feathers that primarily has lifted bird life so far above its ancestral reptilian condition.

The qualities of heat conserving, elasticity, indestructibility, etc., and their beauty have made feathers useful to mankind in a multitude of ways. They are the support of considerable industries, such as the gathering of eider-down and the cultivation of geese for bedding and upholstery; the rearing of ostriches for their plumes; the making of pens, toothpicks, and various ornamental articles. Barbarians, especially those of tropical countries, have always made great use of feathers as personal ornaments or for the decoration of their war costumes and implements. The woven feather cloaks of Mexico and the Sandwich Islands are famous and make rare and expensive exhibits in museums. They were usually identified with chieftainship, and the birds whose feathers were chosen for this purpose were usually considered sacred.

How Fashion Destroyed the Beautiful Birds

Whether in imitation of this savage delight in feathers or not, civilized women a few years ago began wearing feathers and whole bird-skins on their hats. To such an extent was this carried that had not the fashion been changed (with great difficulty), birds of handsome plumage would soon have disappeared from the world. The demand was particularly disastrous because many of the most fashionable varieties could only be obtained at nesting time, and when the parent birds were slain the helpless young birds perished as well through starvation.

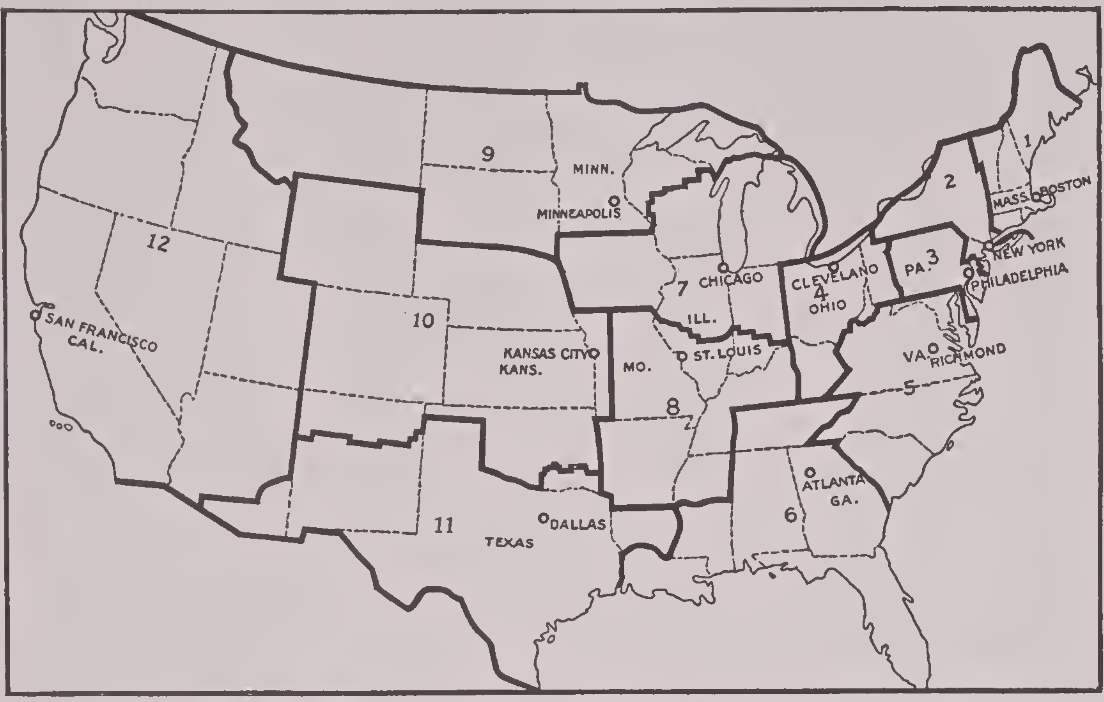
Connected with the ornamental use of feathers are many highly significant and ceremonial usages that make the study of this phase of the subject very interesting. Out of this has grown a considerable body of superstitions, some of which survive—as that widespread belief that the possession of the peacock's tail-plumes is unlucky. The origin or explanation of this silly notion has thus far defied the researches of our folklorists.

FEBRUARY. In the old Roman calendar February (from *februare*, meaning "to purify"), the second month of the year, had 29 days, but it was robbed of one day in order that August (named in honor of the Emperor Augustus) might have 31 days, the same number as had been given to July (named after Julius Caesar). Only in leap year does February recover its long-lost 29th day. (*See* Calendar.)

FEDERAL RESERVE BANKS. The 12 federal reserve banks of the United States are the basis of the country's entire banking structure. These are "bankers' banks" and have no direct dealings with the public. One is located in each of the 12 federal reserve districts into which the country is divided. Every national bank is required to subscribe 6 per cent of its capital to the stock of the reserve bank of its district, and state banks are allowed to become members on the same conditions. The Federal Reserve Board, which consists of the Secretary of the Treasury, the Comptroller of the Currency, and five other members appointed by the President, has supreme control over the system.

The purpose of the federal reserve system, which was established by the Federal Reserve Act of 1913, is to consolidate the country's banking resources in such a way that currency and credit will be available wherever and whenever they are needed. The primary function of each of the reserve banks is to hold the reserves of the member banks and to issue federal reserve banknotes, which make up a large part of our paper money. Any member bank may deposit its "commercial paper" (promissory notes and bills discounted for customers) and receive in exchange banknotes, or credits on the books of the reserve bank which count as "reserves." Thus an elastic currency is provided, which may be readily increased or decreased with the trend of business conditions, tending to prevent the recurring "panics" inevitable under the old banking system. The efficiency of the new system was abundantly proved by its success in stabilizing the country's finances during and after the World War. (*See* Banks and Banking.)

THE GREAT UNITED STATES OF BANKS



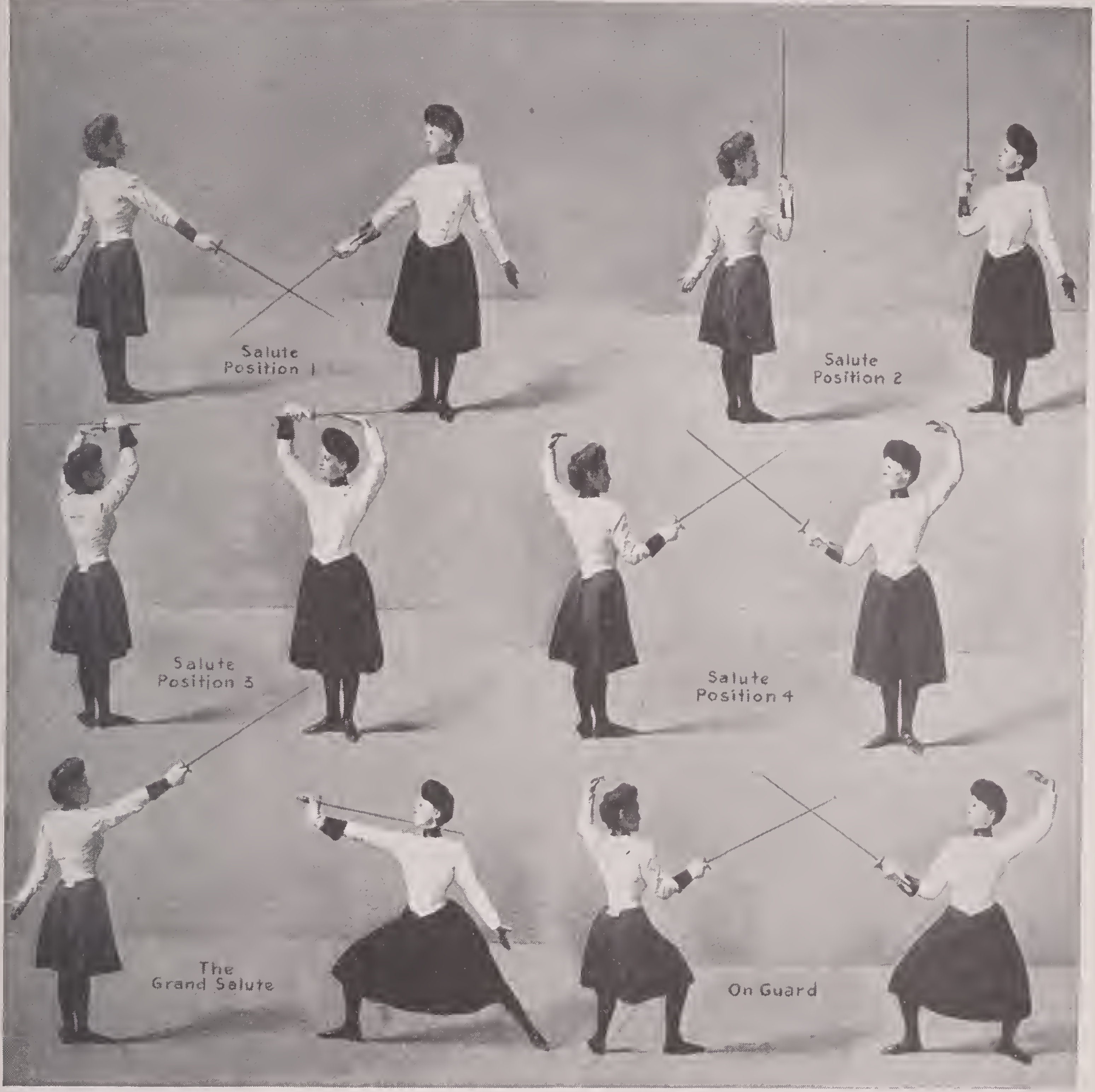
The Federal Reserve Banking System may be said to be a United States within the United States. The map shows the Federal Reserve districts, numbered from 1 to 12. By means of these the united power of all the banks belonging to a district helps to support any individual bank in time of need. The system tends to keep stable the entire business life of the country and provides an elastic interchange of currency and credits, proving a bulwark of safety in periods of financial depression.

FEDERAL TRADE COMMISSION. Business men and companies often take unfair means to crowd out competitors and increase their gains. Often they find it possible to combine with others so that they have a monopoly of raw materials; or get practically all of the business in their own hands and can charge what prices they please (*see* Trusts). As a check upon such unfair practices, in the interest of the public welfare, the United States Congress passed various anti-trust laws which defined the rules of the business "game." Then Congress found it necessary to have an umpire to see that the game was played according to these rules, and in 1914 it passed a law providing for the Federal Trade Commission.

This commission is made up of five men, no more than three of whom can be of one political party, as otherwise they might not act fairly where politics is involved. The purpose of this commission is to prevent unfair tying together of business companies into combines or monopolies, as they are called, that are not in the interest of the public. The commission may also be called upon to untangle combinations already in existence that are abusing their power to work hardships upon the general public by charging unnecessarily high prices. In general the Federal Trade Commission has the regulation of all interstate business corporations except the railroads and the other companies under the regulation of the Interstate Commerce Commission, and the banks, which are under the regulation of the Federal Reserve Board

FELDSPAR. A group of minerals composed of silicate of aluminum together with potassium, sodium, and calcium. There are several varieties, known as soda-feldspar, lime-feldspar, potash-feldspar, etc. Most igneous rocks (granite, gneiss, etc.) are made up of crystals of some kind of feldspar, associated with some other mineral or minerals, and the identity of the feldspar they contain is the basis for their classification. The potash and potash-soda feldspars, within certain limits of temperature, melt without becoming fluid and on cooling form a strong colorless or very light-colored glass. For this reason they are extensively used in the manufacture of porcelains, serving as a flux to bind together the other materials, clay and flint. Feldspar (also spelled "felspar") is also one of the principal ingredients in the glaze for chinaware and tiles, and in opalescent glass. Moonstone is a variety of feldspar. (*See* Minerals.)

ONE FORM OF DUELLING THAT HAS BECOME A SPORT



Fencing skill was formerly essential to gentlemen in the days when street brawls and duels were common. But these times have passed, and practice with the foils has become a form of athletics for women as well as men. Old-time duelling formality is preserved in modern fencing etiquette, as you can see from these pictures showing the commencement of the bout. From Position 1 the foil is swept up toward the chin as shown in Position 2. Then the point is swept forward and down, to the rear and up to Position 3. From here it is dropped to Position 4, and then the right foot is advanced, putting the fencer "On Guard." The "Grand Salute" is used to end a bout.

FELT. A fabric formed without weaving by matting together fibers of hair, wool, or fur with the aid of moisture and heat by a process of rolling, beating, and pressure. Felt is used for many purposes, such as hats, carriage linings, pianoforte hammers, surgical dressings, etc. In Asiatic countries floor coverings of felt have been made from remote antiquity and are still widely used. (*See* Cloth.)

FENCING. Quickness of eye, speed of thought, and swiftness of muscle are of the essence of fencing. The fencer faces his opponent with every nerve in his body alert; he stands poised with his foil darting in and out like a flash of light. Suddenly he sees his opening; he has only the merest fraction of a second in which to take advantage of it, but he does not fail. With a lightning-like movement of arm and wrist and body he sends his button-tipped foil to his opponent's breast and scores a well-earned point.

Fencing is one of the finest exercises in the world. It gives poise, grace, suppleness, and strength on the physical side, and judgment, self-control, initiative, and quickness of thought on the mental side. One of its advantages is that it is equally adapted to boys and girls, men and women.

The equipment needed for fencing with foils includes a tight-fitting padded jacket, a mask made of strong material, a button-tipped foil of flexible steel, and a glove that comes well down on the wrist of the fencing arm.

The position that a right-handed fencer takes when "on guard" ready for a "bout" is with his feet well apart, his right hand bent and pointing toward his opponent, the foil held slightly forward, and his left arm lifted so that the hand is about level with the top of his head. When he "lunges" he throws his right foot forward a few inches, bends his knee at right angles, and, straightening his foil arm, thrusts his weapon quickly at his adversary, at the same time lowering his left hand to a point within a few inches of his left thigh. A "feint" is a movement to mislead; a "parry" is the warding off of the opponent's foil. There are eight simple parries, known as *prime*, *seconde*, *tierce*, etc.

You do not need to be an expert to enjoy fencing, for it is an easy matter to learn the simple attacks and parries and the farther one goes in the sport the more fascinating it is, for there is unlimited opportunity to develop skill and *finesse*.

The history of the sport is interwoven with the history of mankind, for it started centuries ago in those lawless days when a man's life was not his own unless he could defend himself with the sword. Henry VIII of England was the first to give fencing a recognized standing as an English sport.

FERMENTATION. When milk sours or bread rises, when fruit decays, when you digest food, when alcohol is produced in sugary substances and when that alcohol turns again to vinegar, you have in every case an example of the process called fermentation.

Fermentation is always due directly or indirectly to living organisms, and consists of the breaking up of some substance into simpler forms. Common yeast, for instance, which is simply a very small kind of plant or bacteria, breaks up sugar into alcohol and carbonic acid gas. But this is not caused directly by the yeast but by a substance called an "enzyme" produced in the living body of the yeast. Similarly our own bodies produce the enzymes which help digest our food. In the case of sour milk, butter, and cheese, the enzymes from certain types of bacteria produce the lactic and butyric acids that change the quality of the milk. Decay or putrefaction is similarly caused by a type of bacteria called *saprophytes*. (*See* Alcohol; Bacteria; Enzymes; Yeast.)

PLANT SURVIVORS *from the* COAL AGE

THERE was a time, ages and ages ago, when ferns were the highest kind of plants that grew. For a long time Nature apparently tried to see how many thousand varieties of mosses and ferns she could make. Most of them have disappeared as higher forms of life crowded them out, but there are still about 4,000 kinds of ferns. Some of them are rock ferns, almost as small as mosses; some are as big as trees. Away back in the remote period that geologists call the Carboniferous Age, the giant tree ferns and their near relatives formed vast forests covering a large part of the earth's surface, and it is their remains that make up the bulk of our coal deposits.

FERNS. Most of the ferns can be recognized at a glance by their characteristically shaped leaves, popularly known as fronds. These possess a single midrib, with little leaflets branching off from either side, making the whole frond look like a large heavy green feather. This is the plan on which most fern fronds are built, though many are constructed somewhat differently. In most common ferns each frond grows directly from a creeping stem or rootstock under the ground, and so the plant resembles a bunch of large green feathers stuck into the ground. Usually the fronds are a beautiful bright green, though some are a dark shiny blue green; and they are delicately cut into fine toothed or lobed edges. Most of the ferns live in damp places in woods or ravines. With the exception of one or two hardy varieties, they wither very quickly after being picked.

Fern "fronds" or leaves begin as little curled-up balls. At the proper time they unroll and spread out in leaf form. The fronds shown here are from the bracken.

Ferns are widely distributed over the world and are of many different habits of growth. Some are but a few inches high, like the little ebony fern, or ebony spleenwort, of damp and rocky ravines and gorges. The tree ferns, chiefly inhabiting tropical countries, tower upwards 30 or 40 feet, and the crowns or leafy portions are immense clusters of fronds, some of which reach a length of 15 feet and more. While most ferns grow on the ground, there is a peculiar group, known as "epiphytes," which lives fastened upon the surface of the trunk or branches of trees (*see* Air Plants).

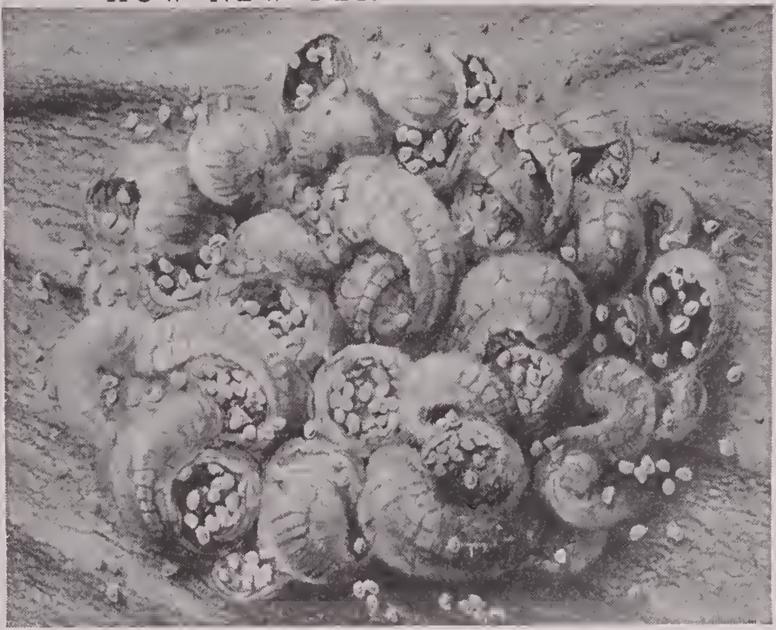
The fern does not grow from seeds as do the higher plants, but from spores. These spores are very minute dustlike grains, each one a single plant cell, produced by one of the fronds of

A "FOREST" OF GRACEFUL FERNS

This picture in the interior of a greenhouse will give you an idea of the amazing variety of form and size found among Ferns. Being shadow-loving plants they thrive in dense clusters like these. The decorative effect of their lace like fronds is unsurpassed among plants, and this, combined with the hardy constitutions that most of them possess, makes them favorites of the household and greenhouse.

the adult fern, and scattered about by the wind. When a spore falls in a favorable situation it grows into a curious little flat green body known as the "prothallus" (meaning "before the plant"). In the prothallus grow little cases containing eggs and others containing very tiny movable bodies called sperms. The sperms are able to swim by means of a little hairlike projection upon one end of the body, and they swim to the eggs at some time when the prothallus is covered with a thin film of water and fertilize them. From these fertilized eggs grow the large fern plants. Botanists call the prothallus the "gametophyte," and the familiar fern plant the "sporophyte." So the life history of a fern plant may be summarized thus: Ferns produce spores; spores produce prothalli; in prothalli grow eggs and sperms; sperms fertilize eggs; fertilized eggs grow into large fern plants again. (*See* Seeds and Spores.)

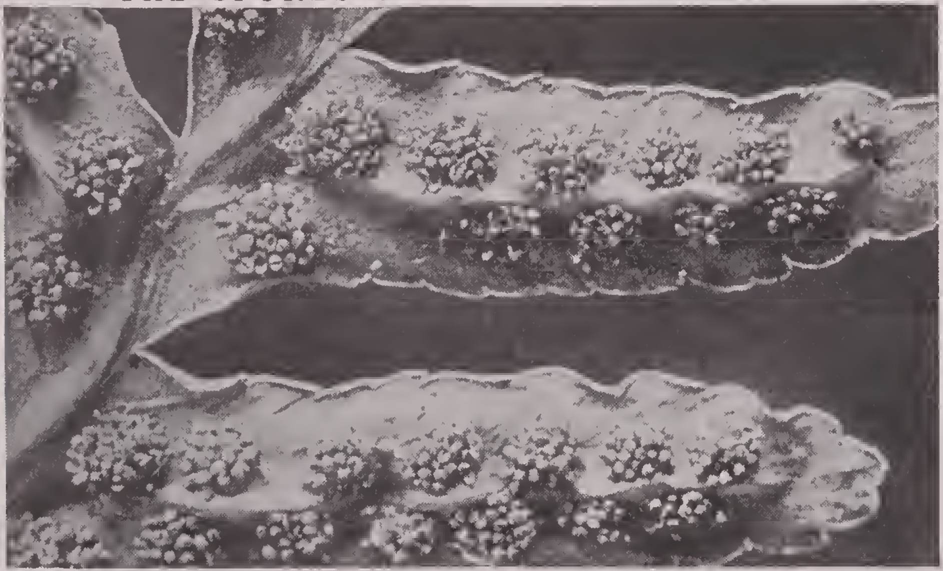
HOW NEW FERNS BEGIN LIFE



Fern spores, from which new ferns grow, are contained in little cases on the under side of the leaves. Around the middle of the case is a rib-like structure which breaks and springs open, ripping the wall and scattering the spores.

Fern fronds unroll as they grow. In the spring we see them as hairy brownish-green balls clustered together on the ground. As the season advances the balls are raised off the ground and begin to unroll until in the later summer the full frond is revealed. In the autumn they turn red, yellow, or brown, and then fall and decay, as do the leaves of the trees. The hardy Christmas fern is an exception, for it remains green throughout the winter.

THE SPORES CLINGING TO THE LEAF



Underneath the leaf the little cases containing the growing spores find shelter. After the spores are scattered by the wind they grow into "gametophytes." The gametophytes finally produce the fertilized "eggs" which in turn grow into the real ferns. Thus fern reproduction is a "two-cycle" process.

Some common ferns are the *royal*, the *cinnamon*, and the tall *swamp ferns:* the *maidenhair fern*, with its dark brown polished stems and its tiny leaflets; the *rock fern*, a very hardy fern, growing on rocks; and the *hay-scented bowlder fern*, common in stony pastures. The term "brake" or "bracken" is applied to the masses of tall coarse fern which grow profusely in neglected meadows and open woodland of the northern United States and in Europe.

Ferns have little economic use, though the coarse brakes are sometimes used for bedding for animals, and in Hawaii mattresses are stuffed with ferns called "pulu." The rootstock of a New Zealand species is used for food, and elsewhere bitter rootstocks of ferns are sometimes used for dressing some leathers and as a substitute for hops in brewing beer. The male-fern is also used at times in medicine.

Fern fronds are easily gathered and pressed, and to collect the ferns of any particular region is a fascinating as well as an instructive pastime. Many excellent books with beautiful illustrations can be obtained to aid the fern lover in identifying his specimens.

Ferns belong to the class *Filicineae* of the division *Pteridophyta*. This latter also includes the horsetails or scouring rushes, and the club mosses, of which the creeping ground pine is a familiar example. A common maidenhair fern is *Adiantum pedatum;* the Christmas fern belongs to the genus *Polystichum.*

FERRET. A slender little quadruped used to drive rabbits out of their holes in rabbit-hunting, and also to kill rats and mice. It is a domesticated breed of the Old World polecat. Even though raised in confinement it never becomes really tame or trustworthy, and will make sad havoc in a poultry yard. The ferret frequently is an albino, with yellowish-white fur and pink eyes; but there is also a brown breed. The body length is about 14 inches, with a tail of 5½ inches.

When used in hunting rabbits the ferret is provided with a muzzle or "cope," which keeps him from killing the prey. If this were not done the ferret would kill the rabbit, gorge himself, and then go to sleep in the rabbit's burrow.

FERTILIZERS. Thirteen chemical elements are necessary for plant growth. Ten of these are usually obtainable in sufficient quantities from air and the moisture of the soil. But three of them—nitrogen, potassium, and phosphorus—are often lacking in certain soils, and are rapidly exhausted by crops. A ton of wheat, for example, takes away from the soil about 47 pounds of nitrogen, 18 pounds of phosphoric acid, and 12 pounds of potash. If the soil is to keep on producing good crops, these substances must be fed to it in proper proportion (*see* Soil). This may be done either by the use of manure, which not only provides the necessary plant foods but also furnishes humus, and so improves the physical condition of the soil itself; or by the application of commercial fertilizers, which merely add the plant foods.

The most important and frequently needed of these plant foods is nitrogen, in the form of nitrates or other nitrogen compounds. One of the chief sources of supply is northern Chile, where nitrogen is scraped off the ground in the form of nitrate of soda (*see* Chile). Other nitrogenous fertilizers are ammonium sulphate, a by-product of the manufacture of coke; various organic substances such as dried blood, meat waste, fish scrap, and cotton-seed meal; and artificially fixed nitrogen in the form of calcium nitrate and calcium cyanimide. The World War of 1914–18 gave great impetus to the problem of the fixation of nitrogen, for both explosives and fertilizers, and already a considerable proportion of nitrogenous fertilizers is so obtained (*see* Nitrogen). Commercial fertilizers, however, play a small part in restoring nitrogen to the soil in comparison with the work of manure and such leguminous crops as alfalfa, which, unlike other crops, replenish instead of exhausting the nitrogen of the soil (*see* Alfalfa).

Crushed phosphate rocks found in South Carolina, Florida, Idaho, Tennessee, Utah, Wyoming, Montana, as well as in other parts of the world, form the principal source of phosphorus fertilizers. The rock is either applied direct after crushing, or it is treated with sulphuric acid, which makes the phosphoric acid easier for the plants to take up. The bones of animals are also rich in phosphoric acid. They are usually finely ground and applied to the soil, but sometimes are treated with sulphuric acid, like the mineral phosphate. These bone phosphates act more slowly than the rock phosphates. A third source is basic or phosphate slag, a by-product in the manufacture of steel from certain kinds of iron. It is produced in large quantities in England, France, and Germany.

Germany was formerly the world's principal source of supply for the potash fertilizers. They are mined in the form of chlorides or sulphates of potash from the inexhaustible Stassfurt deposits in Prussian Saxony. Immense deposits also occur in Alsace, now restored to France. When the German potash fertilizers were cut off by the World War, the United States attempted to produce a domestic supply, and by the close of the war the production was nearly one-fourth of the normal consumption. Some of the sources drawn upon were the natural brines of the alkali lakes, kelp, distillery waste, cement-dust, wood-ashes, and beet-sugar by-products. (*See* Potassium.)

Guano, a deposit formed especially on the Pacific South American coast and islands by the excrement and carcasses of sea-birds, was once the most important commercial fertilizer, and huge fortunes were made in the trade. But the supply has now been so exhausted that it is unimportant except locally. Other substances sometimes used as fertilizers are wood-ashes, ground limestone, powder waste, coal-ashes, mussel and lobster shells, marl (a soil consisting of clay and carbonate of lime), sewage, and street sweepings.

Fertilizers are of so much importance to agriculture today that nearly all states have laws compelling manufacturers to label their product truthfully with exact percentages of fertilizing agents it contains. The best way of determining what sort of fertilizer a piece of land requires is to consult your state agricultural college, which usually has surveys of the various soils of the state and gives advice free. (*See also* Agriculture.)

FEUDAL SYSTEM. Suppose by some great national misfortune the government of the United States and of the separate states should suddenly vanish, with the army, navy, the police and courts, and all the machinery of law-making, taxation, road-making, and public services. Where would men then find protection for themselves and their families, and how would the work of government be carried on?

We know what the answer was in the similar situation when the German barbarians swept down from the north and overthrew the old Roman Empire, from the 4th to the 9th centuries. That answer is summed up in the word feudalism, or the feudal system, which someone has described as "anarchy roughly organized."

The following was the system which, in outline, was set up in different parts of western Europe, and lasted until the end of the Middle Ages. First of all there was a king surrounded by a body of attendants. In theory he owned all the land, though the actual use of a large portion of it was enjoyed by some 400 or 500 great landholders, each possessing one or more strong castles, who received the land on condition that they should each help the king with counsel and aid him in war with an agreed number of mounted men. The actual use of much of the land of these great landholders was enjoyed by other men, who were similarly masters of strong castles, on the same condition of military and other service as that under which the great landholders themselves held from the king. These in turn subdivided their lands, until at the bottom of the feudal scale were lords who had just enough land and peasants so that the holder was enabled to live comfortably and provide himself with horse and weapons for fighting. Each of these landholders was a little king inside the limits of his own

A VASSAL "DOING HOMAGE" IN FEUDAL DAYS

Here is a vassal kneeling before his feudal lord, with both his hands placed in those of his lord. He says, "Sire, I become your man from this day forth, of life and limb, and will hold faith to you for the lands I claim to hold from you; and I will serve you in all ways that a free man should." Then the lord raises him to his feet, and the vassal swears his "oath of fealty," after which the lord "invests" him with, or puts him in possession of, his "fief" by handing him that lance which the nearest man-at-arms holds. In return for his fief the vassal performed military service for his lord. Notice the helmets and coats-of-mail worn in this picture, and also the furnishings of the lord's great hall, especially the hooded fireplace in the background.

land, and all were fighting together most of the time. All these landholders were "nobles" and "lords." Their household servants and the peasants who worked their lands were "serfs" or "villeins," for the whole feudal system rested on a substratum of serfdom (*see* Slavery and Serfdom). Those who controlled a good many villages and serfs, and to whom a good many other "vassals" (as they were called) owed military service, were barons, counts, or dukes.

The ceremony by which a man became a vassal usually took place before a number of other vassals. The man who was to receive the land knelt at the feet of the king or lord, and placing his hands within those of the lord declared that he became his "man" to serve him in all such ways as a free man should serve his lord. This ceremony was called doing homage, from the Latin word *homo*, meaning "man." Next the vassal arose and placed his hand on the Bible or some saint's bones, and swore to keep the promise he had just made. This was the oath of fealty. Finally the lord, as a sign that the vassal had become the holder of the land, handed over to him a clod of earth or a twig, or other object (investiture). The vassal was now said to hold a "fief," which would pass to his eldest son on his death, and for which only occasional payments were made—as when the lord knighted his eldest son, married off his eldest daughter, or must be ransomed from captivity. Thus was formed a solemn contract binding on both parties. The king, for example, could not tax his vassals—except on the three occasions named above—unless they had first given their consent. In England the vassals made use of this principle steadily to limit the power of the king.

The feudal system took shape in the 8th to the 10th centuries. France was the land of its earliest and most complete development, but in some form it was found in all countries of western Europe. It flourished preëminently from the 10th to the end of the 13th century. After that period a transformation set in, through the increasing power of the kings, supported by the church and the newly arising towns, with their commerce and wealth, and the new weapon of gunpowder, which enabled the government to blow to pieces the rocky castles of the defiant robber barons. Even down to the 19th century there remained many survivals of feudalism, in the laws, landholding, and social usages of European countries. (*See also* Agriculture; Castle; Knighthood.)

FIELD, EUGENE (1850–1895). In his charming home in Chicago, the social center for a large circle of literary friends, this American poet and journalist had a famous workroom and library to which he admitted his intimates. It was lined to the ceiling with first editions of classics and books in costly bindings; and cabinets and tables were filled with curios, for Eugene Field was a collector of the rare and beautiful in books and articles of artistic workmanship. But also, out of pure sentiment, he collected and cherished absurd and worthless things, as a mother keeps the little worn shoes of a baby. Among all those treasures of literature and art, he displayed with loving pride the battered outgrown toys of his seven children who were the joy of his life. Tarnished trumpets and broken drums, torn balls and stringless tops, dismembered animals, "spinster dolls," paintless blocks, wrecked sailboats, and dog-eared picture books were tucked away in odd corners; and on his desk at times stood a shorn lamb, a china dog with a broken nose, or a "little tin soldier red with rust." And it was from these that the Poet Laureate of Childhood drew inspiration for his 'Little Boy Blue' and other poems that made his name a household word in America.

EUGENE FIELD
Poet of Childhood

Born in St. Louis, but of New England ancestry, Eugene Field combined the best qualities of East and West. His early years were spent in Massachusetts and he was educated at Williams College (Massachusetts), Knox College (Illinois), and the University of Michigan. Then he was employed on newspapers in St. Louis, Kansas City, and Denver before he found a permanent berth, and the leisure to do his distinctive kind of work, on the Chicago *Daily News*. His scholarly and graceful translations from the Latin poet Horace, and his prose tales and sketches, marked by a learning, sentiment, and humor that recalled Charles Lamb and Oliver Wendell Holmes, would alone have won for him a distinguished place in American letters.

But all his other work was eclipsed by the poems in which he expressed the beauty, innocence, appeal, whimsicalities, and bubbling fun of childhood. The charming simplicity and spontaneity of his juvenile verse, with its sympathetic insight into the shy little minds and hearts of children, have not been surpassed even by Stevenson and Riley. Several of his cradle songs have been set to music.

No sketch of Eugene Field would be complete without reference to the testimony of numerous devoted friends that the man himself was as fine and rare in quality as anything he wrote. Fortune had given him the mobile face that made him the ideal entertainer in the social circle and on the lecture platform; and his mind, in its infinite variety of wit, wisdom, mirth, and sentiment, was like that of a court jester of knightly days. It was a matter for wide personal grief, as well as a public loss, when this gifted poet died at the early age of 45, before his own brood of little children was grown up.

Eugene Field's works include: 'A Little Book of Western Verse' (1889); 'A Little Book of Profitable Tales' (1889); 'With Trumpet and Drum' (1892); 'Echoes from a Sabine Farm' (translations from Horace), 1893; 'Love Songs of Childhood' (1894); and, in collaboration with his brother Roswell Field, 'Love Affairs of a Bibliomaniac' (1896).

FIGS. Every time you eat a Smyrna fig you owe thanks to the fig-wasp, for without this tiny insect no bigger than a gnat we would have none of those luscious fruits, which from the earliest times have been the best figs in the world, whether fresh or dried.

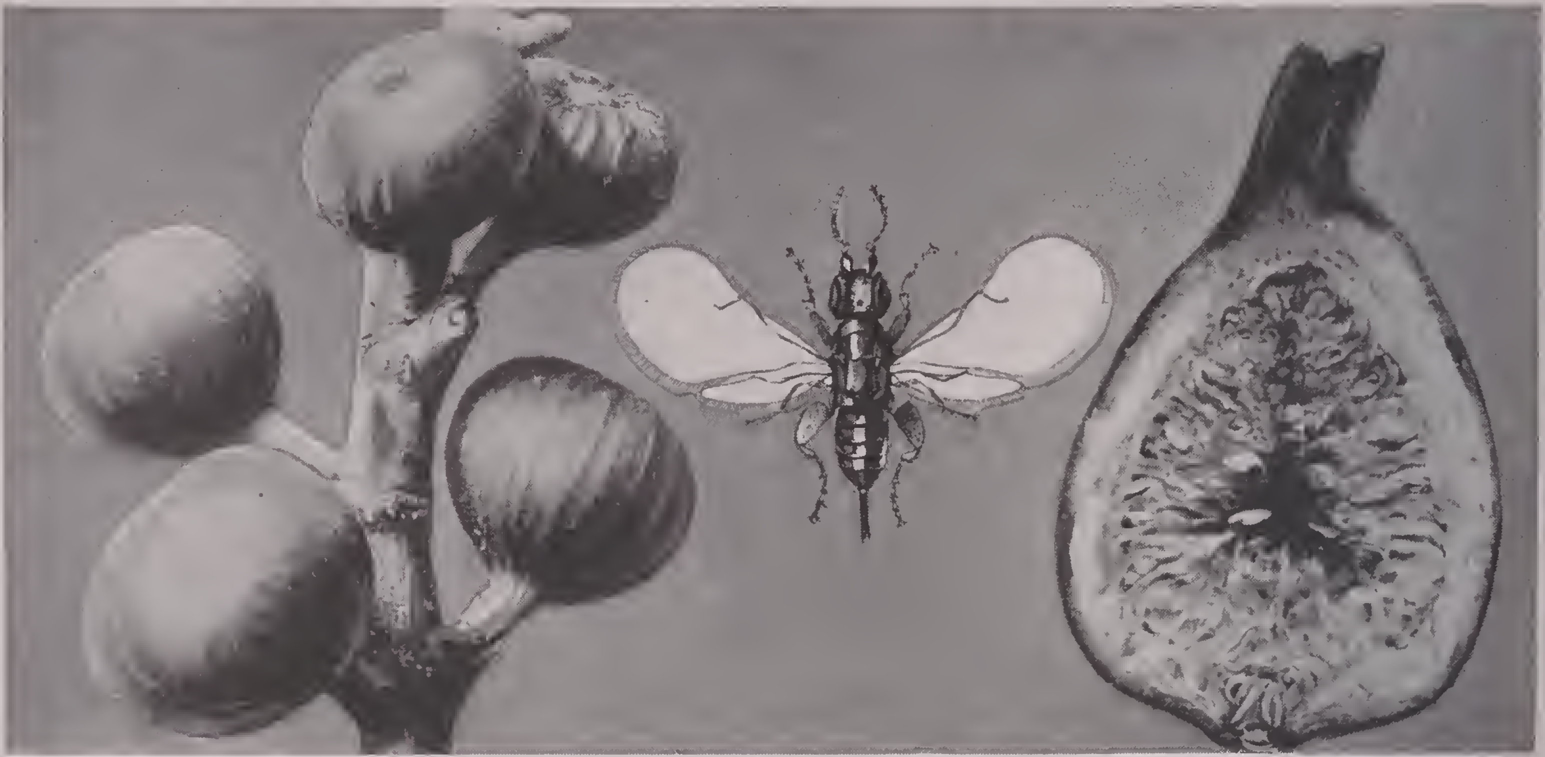
The part these little wasps play in the life of the Smyrna fig is in aiding cross-pollination. The buds cannot develop unless they are fertilized by the pollen of the Capri fig, a wild species that bears only sour and pithy fruit. This is due to a peculiarity in the structure of the Smyrna fig. The luscious pear-shaped figs, full of delicious pulp, are not the true fruit of the tree. They are rather the receptacles within which the little fig-flowers grow and ripen in great numbers, forming the true fruits, which we commonly call the "seeds." This receptacle is closed save for a little hole at the very tip, so that cross-pollination cannot be accomplished in the usual way—by the wind or by ordinary insects.

The fig-wasps breed in the fruit of the wild fig. At the proper time bunches of these wild figs are hung in the tops of the cultivated trees, and when the little wasps push out to find a place to lay their eggs, their bodies become covered with the pollen from the wild-fig flowers. As they enter the Smyrna fig, this pollen is brushed off on the flowers and fertilizes them. This process is called "caprification." One Capri fig tree is sufficient to pollinate 100 cultivated trees.

While figs can be grown over the entire United States, south of Pennsylvania, fig culture was not attempted until a few years ago. Then Smyrna fig trees were brought to California for cultivation on a large scale. For years there were heavy financial losses and great disappointment, for the fruit did not ripen properly. Men of science were sent to Asia Minor to study the tree in its native home, and there discovered the important part the fig-wasp plays. So Capri fig trees were planted, and little fig-wasps were carefully packed and brought across thousands of miles to the California groves. Now the figs of California rival those of Smyrna, and the drying of figs has grown to be commercially important.

There are many varieties of fig which do not require cross-pollination, but their fruit is not so delicious and cannot be dried so easily and well as the Smyrna fig. The different species vary greatly, some being low trailing vines, and others good-sized trees. The fruits vary in color from deep purple to yellow or nearly white. The Smyrna fig is a small bushy tree and rarely grows more than 18 or 20 feet high. The India-rubber tree (*Ficus elastica*), from which most of the East India rubber comes, is a species of fig.

STORY OF THE WASP THAT HELPS MAKE FIGS



Have you ever noticed the rounded hole in the end of a Smyrna fig? Its existence enables Nature, with the aid of the tiny fig-wasp here shown (considerably enlarged), to perform one of her most unusual bits of magic. The Smyrna fig does not ripen unless it is provided with pollen from the Capri fig. The little wasps grow to maturity in the Capri fruit, then crawl through the hole into the Smyrna fig and deposit inside of it the Capri pollen that clings to their bodies. Thereupon the fig ripens into the delicious fruit we all love.

As far back as history goes the fig has been a house-yard tree. "Beneath the vine and fig-tree" is used more than once in the Old Testament to designate "home." For centuries the fruit, fresh or dried, has made up a large part of the food of the natives of western Asia and southern Europe. Its juice is used to make a drink and also to dye cloth; its leaves polish ivory and the bark makes cord. The sap of one species is poisonous.

The fig tree, in climates congenial to its growth, produces two and sometimes three crops of fruit the same year, on distinct shoots. The trees grow readily from cuttings, and are also propagated by budding, grafting, and seeds. The large beautiful leaves are deciduous, palmately veined, three- to five-lobed, wavy-margined, and somewhat rough and leathery.

Scientific name of the edible fig, *Ficus carica*. The four chief varieties are *sylvestris*, *smyrniaca*, *hortensis*, and *intermedia*. The *sylvestris* is the all-important wild fig or Capri fig, in which the little fig-wasps (*Blastophaga grossorum*) breed. The *smyrniaca* is the best of all figs. The *hortensis* variety includes all the self-fertilizing table figs. The *intermedia* can mature one crop without pollination, but not two.

FIGURES OF SPEECH. Perhaps you know Eleanor Gates's story of 'The Poor Little Rich Girl', who is so puzzled and troubled when she is told that the footman "murders the King's English," that her governess is a "snake in the grass," her nursemaid is "two-faced," and her mother has "the society bee in her bonnet." All this seems very dreadful to the little girl because she takes it all literally—that is, word for word—and does not understand that these are only fanciful ways of putting things, or what we call "figures of speech."

Another name for figure of speech is *trope* (the Greek word for "turning"). That is what a figure of speech is—a turning of words from their usual meaning or order for the purpose of clearness, emphasis, or beauty.

When Wordsworth says of Milton, "Thy soul was like a star and dwelt apart," we get a stronger impression of Milton's loftiness of spirit and his solitude than the plain words could possibly give us. This figure of speech, in which there is an expressed comparison of one object to something of an entirely different order, by the use of the terms *like*, *as*, *so*, etc., is called "simile."

When Shakespeare says—

> There is a tide in the affairs of men
> Which taken at the flood leads on to fortune,

he does not expressly compare opportunity to a tide, but leaves the comparison to be inferred from his words. This figure of speech, in which a comparison between two unlike objects is not stated but only *implied*, or in which one is identified with the other, is called "metaphor." It is a more daring and generally more powerful figure than simile. It is exposed, however, to the danger of what is called "mixed metaphor," as in the case of the Irishman who said of his opponent that he "never opened his mouth but he put his foot in it."

When the metaphor represents a lifeless object as a person, we call the figure "personification." Thus Shelley speaks of the moon as "that orbed maiden with white fire laden."

Sometimes in order to arrest attention or to produce a vivid impression, the writer or speaker expresses more than the truth, or exaggerates, as when Washington Irving pictures Ichabod Crane with "hands that dangled a mile out of his sleeves" and "feet that might have served for shovels." This figure of speech is known as "hyperbole."

Some figures of speech owe their force to the use or arrangement of words in such a way that the sound aids the sense or produces greater emphasis. Thus, in "alliteration" the effect is produced by using words beginning with the same sound in close succession, as when we speak of "might and main," "vigor and vim," etc. Often the effect of alliteration is very beautiful, as in Swinburne's "With lisp of leaves and ripple of rain." But often in common use alliteration is a mere trick, obvious and artificial, and without beauty or force. The same may be said of all figures of speech; to be really effective they must not be forced, but must be the natural flower of the imagination and feeling.

FIJI (*fē'jē*) **ISLANDS.** A hundred years ago few white men in the Pacific could be induced to visit the beautiful Fiji Islands, for no spot on earth had a more evil reputation. The handsome dark-skinned natives, with their high mops of frizzled hair, seemed courteous and intelligent at first, but in reality they were most cruel and treacherous cannibals. On quiet nights the sinister roll of the cannibal drums and the glare of the feasting fires warned ship captains far out at sea to beware the Fiji reefs.

Yet today there are no more law-abiding prosperous places in the South Seas than these same Fiji Islands. In 1874, old Thakombau, the famous "King of the Cannibal Islands," put his country under British rule; and although cannibal feasts were held in secret as late as 1890, the old men living today who took part in them are looked upon with horror by the younger generations.

The Fiji group, situated east of Samoa and about 1,200 miles due north of New Zealand, is composed of about 250 islands, 80 of which are inhabited. The largest, Viti Levu, is 98 miles long and 67 miles wide; the second in size is Vanua Levu, 117 by 30 miles. The others are all much smaller. Approaching Suva, the capital, by steamer, it seems impossible to believe that the dark tragedies of the past could have taken place in surroundings of such entrancing beauty. The deep blue of the ocean passes gradually into turquoise and emerald among the coral reefs, where the shallow waters are filled with multi-colored fishes. Circling the shore-front is a magnificent avenue lined with trees and white houses. Beyond the town the hills are clothed in the thick dark green of the tropical vegetation, all aflame with the scarlet hibiscus blossoms. On Viti Levu, as on the other large islands of the Fiji group, the coast hills rise rapidly to high peaks, most of them ancient volcanoes, often more than 3,000 feet high.

The islands are fertile, have a tremendous rainfall, and countless rushing rivers, one of which, the Rewa on Viti Levu, can be navigated by small boats 50 miles inland. The chief products are sugar, copra (dried coconut kernels), rubber, bananas of excellent quality, coffee, tea, rice, pearl-shell, turtle-shell, trepang (smoked sea-cucumbers), and rare woods. Occasional hurricanes destroy the crops and rip down the flimsy native dwellings, but the usual climate is excellent for the tropics.

Fiji is a British crown colony, with a governor at Suva assisted by provincial commissioners, several of whom are native chiefs. The governor is also British high commissioner for the western Pacific, thus having control of most of the smaller British islands in the South Seas.

During the 19th century the diseases of the white men threatened to kill off the Fijians, whose bodies were unaccustomed to resist contagious germs. In 1875 an epidemic of measles claimed 40,000 victims. But today the native population is slowly increasing again and is now about 150,000, of which 90,000 are Fijians, 4,000 whites, 40,000 East Indians, and the remainder Chinese or natives of other Pacific islands. The coolies from India and China have been brought in largely because the native Fijian profoundly dislikes hard and prolonged labor even when profitable. (*See* map with article Pacific Ocean.)

The Thirteenth PRESIDENT *of the* UNITED STATES

FILLMORE, MILLARD (1800–1874). Millard Fillmore's life is a demonstration of the claim that "any American boy may become president." Unaided by wealth or influential friends, he climbed from the log cabin of a frontier farm of western New York to the White House in Washington—from a position as apprentice to a wool-carder to the highest position in the land.

His father came from New England and settled in Cayuga County, N.Y., as a frontier farmer, but the struggle to get along was so severe that he resolved that his sons should each be taught a trade so that they would not have to face such hardships. When his second son, Millard, was 14 years old, he apprenticed him for the term of seven years to a wool-carder and maker of cloth. The master was so cruel to the boy that at one time the latter threatened to kill him with an ax.

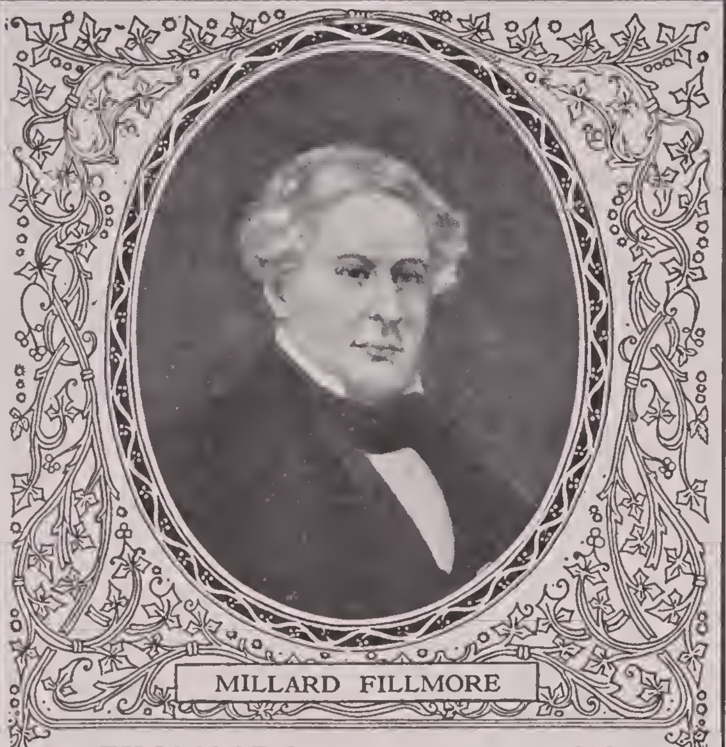
When young Fillmore was 19 he decided to study law. As he still owed two years' service to his master, he "bought his time" for $30 and set out for Buffalo. There he persuaded a lawyer to let him work in his office for his room and board. Money for his other expenses he earned by teaching school. This fact gives us an idea of the inadequacy of the schools of that time. All of Fillmore's schooling had been obtained before he was 14 by attending school three months out of the year, and his first book, an English dictionary, had been purchased only a few months before he went to Buffalo.

After eight years in a law office he was admitted to the bar in 1827, and began the practice of law at Aurora, N.Y. He returned to Buffalo in a few years, and by 1840 his law firm was one of the best known in the state. Though Fillmore was never a brilliant lawyer, he was a conscientious worker and had a sound legal knowledge.

His political career began with the birth of the Whig party, to oppose the Democratic party of Andrew Jackson, and it ended with the death of that party on the eve of the Civil War. The first time he was elected to office was in 1828, when he was chosen a member of the New York legislature; the last was in 1848, when he was elected vice-president of the United States.

Fillmore's Record in Public Life

In the legislature Fillmore's chief service was in securing the passage of a law to abolish imprisonment for debt in that state. In Congress, where he served several terms (1833–1835, 1837–1843), he was author of the tariff law of 1842, which provided high duties on imports. To him also was due the appropriation by Congress of $30,000 to aid Samuel F. B. Morse in perfecting his invention of the telegraph. On the burning question of slavery he pursued a moderate course, keeping free from pledges to either side. This made him acceptable to both Northern and Southern Whigs, and led to his election as vice-president with Gen. Zachary Taylor in 1848.



MILLARD FILLMORE

FILLMORE'S ADMINISTRATION
1850–1853

Webster made Secretary of State.
Compromise of 1850, including new Fugitive Slave Law.
Maine adopts prohibition (1851).
Postage reduced from 5 to 3 cents (1851).
Clay and Webster die (1852).
'Uncle Tom's Cabin' published (1852).
Perry's mission to Japan (1853).

As vice-president he was called upon to preside over the Senate during one of the stormiest debates in the history of the country, that on the slavery compromise measures of 1850. Since 1826 no vice-president had made an attempt to call the senators to order when they became too heated in debate, but during this debate Fillmore resumed the right. His position was made difficult by the fact that his attitude of concession to the slaveholding South differed from that of President Taylor.

How He Became President

In the midst of the debate Taylor died, and on July 9, 1850, Millard Fillmore became the 13th president of the United States and the second "accidental president" who had succeeded to that office from the vice-presidency. He formed a new cabinet with Daniel Webster as secretary of state. Backed now by the President's influence, the compromise measures were soon passed and were signed by Fillmore, because he felt that only by them could the Union be preserved. (*See* Compromise of 1850.) His signature to the new Fugitive Slave Law, which was part of the compromise, lost him the support of the Northern members of the Whig party, and cost him reëlection in 1852. During the continuance of the slavery dispute it was impossible for any president to suit both North and South, and no president from Jackson to Lincoln served more than one term.

As Fillmore was a Whig and Congress was Democratic, little important legislation was passed except the compromise. But in foreign affairs an important step was taken in the despatch of an expedition under Commodore Perry to Japan. This began the negotiations for the treaty of 1854, which opened Japanese ports to American vessels and paved the way for the introduction of western civilization into that kingdom.

The great Whig leader, Henry Clay, on his deathbed had recommended that President Fillmore be renominated in 1852; and Daniel Webster said that his administration was one of the ablest that the country had known for years. But the Southern Whigs were lukewarm, and many of the Northern ones bitterly opposed him as a "Silver Gray" or "Cotton" Whig. So he was passed by in the convention and the nomination given to General Winfield Scott, who, however, was defeated by Franklin Pierce, the Democratic candidate.

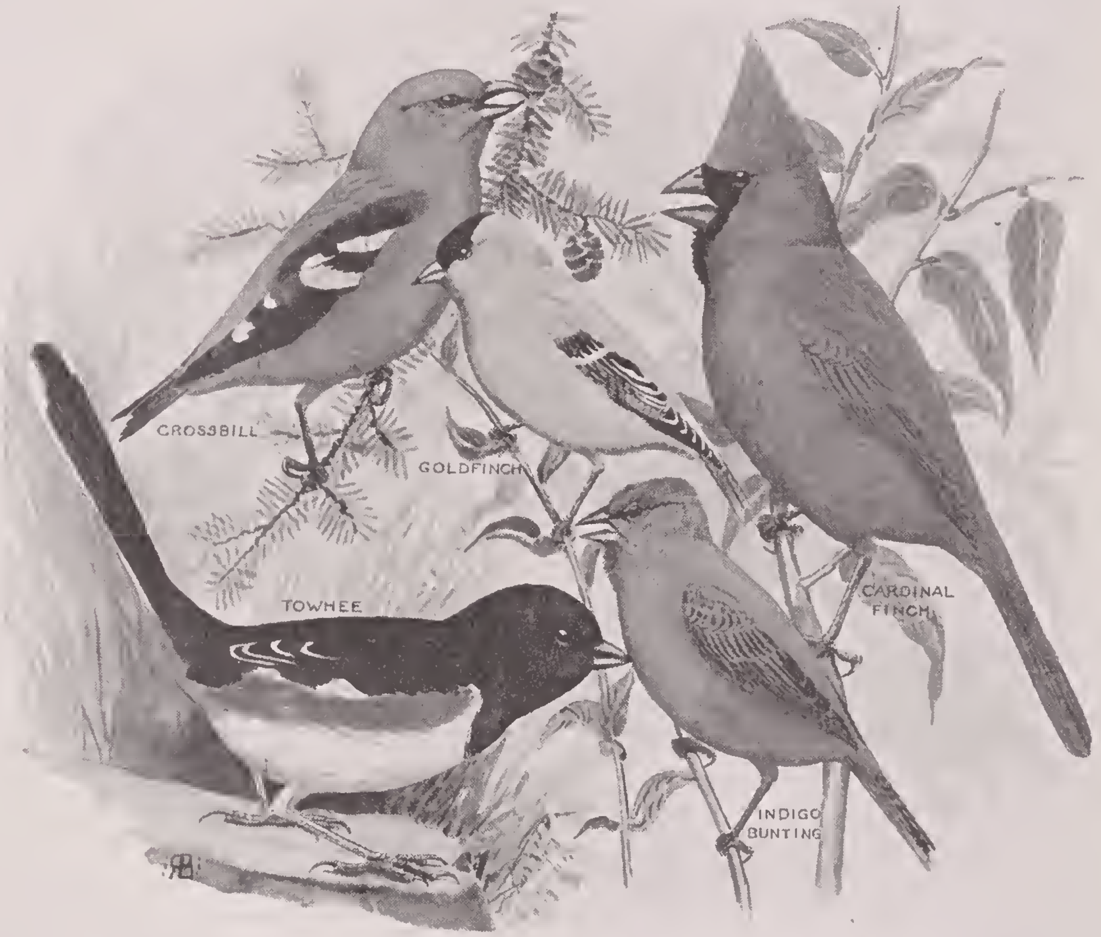
The Passing of Fillmore and the Whigs

At the next election, in 1856, the expiring Whig party, in alliance with a party called the "Know Nothings," thought better of their neglect and made Fillmore their presidential candidate; but he was badly defeated at the polls by the Democratic candidate, James Buchanan. He obtained the electoral vote of only a single state, Maryland. This was Fillmore's last appearance in public life, though he maintained his interest in political affairs until his death, 18 years later. His last years were spent in his luxurious home in Buffalo, in striking contrast to his boyhood days.

In spite of his lack of early advantages, President Fillmore possessed, we are told, "a grace and polish of manner which fitted him for the most refined circles of the metropolis." His sound learning is shown by that fact that when he visited England in 1855 he was offered the degree of D.C.L. (Doctor of Civil Law) by the University of Oxford, an honor which he declined.

FINCH. Twelve hundred different species of finches, scattered through the temperate and tropical countries of the world, make up the family known as *Fringillidae*, the largest of all bird families. All have the stout bill, conical in shape, with great seed-crushing power, and the 9 feathers in the hand section of the wing, with 12 tail feathers. They migrate, if at all, over but a small area, and most of the species nest on the ground or in low trees or bushes. Little harm can be said of any member of this large group, and all are valuable aids to the farmers, as they feed largely on weed seeds.

POPULAR MEMBERS OF THE GREAT FINCH FAMILY



The finches are all frisky little chaps that everybody likes. The farmer likes them because they eat the seeds that produce weeds and they let his grain alone. Nature lovers are fond of them because they are so often beautifully colored. The only member of the family that makes himself a nuisance is the "city chap," the English sparrow who is so abundant in all towns.

The plumage of the finches varies from the dusky colored sparrows to the vivid blues, scarlets, and yellows of the more brilliantly colored species. The vocal powers also vary, for the finch family includes along with its non-singing members such songsters as the cardinal, the grosbeak, and the goldfinch.

About 200 species of finches are found in the United States. Of these the goldfinch is one of the most common. About five inches long, the male bird is a golden yellow, with a black crown and wings (for illustration in colors *see* Birds). He and his olive green mate are found wherever dandelions and thistles seed. His habits and song are as cheery as his coat.

The indigo bunting is another popular finch. He is about the size of a goldfinch and has been described as "the bluest bird that flies." His song is one of the few to be heard in the midday heat of summer. The female is feathered in dull brown.

A curious finch is the crossbill, for the curved mandibles of his sharp-pointed bill cross in a way that gives the impression of a deformity. This is really a special and very clever adaptation to the bird's feeding habits. A few quick strokes of his curious beak will cut an apple into pieces and allow the scoop-like tongue to take the seeds, which the crossbill prefers to the fruit itself.

The junco is a hardy little member of this family. He wears a trim quaker coat and a black cap and breastpiece. Though naturally shy, when winter snow covers his feeding grounds he, in company with the sparrows and chickadees, is very glad to accept man's hospitality.

Another interesting finch is the towhee, which gets its name from its call-note. It is also called a chewink, for some students of birds think the latter word more nearly represents the sounds it utters. The towhee is a skilful ventriloquist and has two other notable peculiarities—one its habit of scratching like a hen and the other its apparent unconcern when its nest is approached. When the nest is actually discovered, however, it betrays much alarm. The towhee is eight inches long, with a black head, chest, and upper parts and white or brownish underparts.

The scientific name of goldfinch is *Astragalinus tristis*; of indigo bunting, *Passerina cyanea;* of crossbill, *Loxia curvirostra minor;* of junco, *Junco hyemalis;* of towhee, *Pipilo erythrophthalmus*. (*See* Bunting; Cardinal Bird; Grosbeak; Sparrow.)

The ARTIST'S ETERNAL QUEST *of* BEAUTY

"Great nations," says Ruskin, "write their autobiographies in three manuscripts—the book of their deeds, the book of their words, and the book of their art. Not one of these books can be understood unless we read the two others; but of the three, the only quite trustworthy one is the last. The acts of a nation may be triumphant by its good fortune, and its words mighty by the genius of a few of its children, but its art only by the general gifts and common sympathies of the race." What is the origin of this universal reaching out for beauty which is the source of what we call the Fine Arts? What are the various ways in which it finds expression? What are the characteristics of truly great art? The accompanying article presents as simply as possible the answers to these and other questions that arise in considering this most fascinating of human activities.

FINE ARTS. The various arts are broadly divided into two classes, ordinarily distinguished as the useful arts and the fine arts. The meaning of the former of these terms is self-evident. It includes such branches of activity as industrial arts, manual arts, household arts, and others. The fine arts can only be said to begin when there is a distinct reaching out for the expression of beauty in the form of the thing created, and when there is added to this endeavor the effort to make the form more beautiful by means of suitable decoration.

Man shudders with the cold and rain, or suffers from the sun's heat, and builds a roof and four walls within which to live. He has produced a work of useful art—the useful art of building. But suppose he makes his roof project, so that a deep shadow will fall upon the walls when the sun shines, and that he makes the chimneys large, so that the house will not only be, but *seem* to be, a place of shelter and of warmth. And suppose that his columns are made broad at the base and lightened with decoration at their tops, so that they seem to *prefer* to stand on end, as they do, and support the roof that is above them. Then the house does more than merely withstand the elements; it goes so far as to *celebrate its triumph over them.* This is the *fine art* of building. Here we see *architecture* as a form of emotional expression—a language of the feelings.

This theme of triumph, it may be observed, has been sung, not in this art alone, but in every form of fine art. From the first aboriginal song and dance, down to the days of the Sousa marches, triumph has found expression in the fine art of *music.* In the days of the Romans, and before and since, it has been celebrated in the fine art of *sculpture.* In the days of the Egyptians, as in our own, the theme has been voiced through the fine art of *painting.* And in all times the fine art of *poetry* has made triumph and beauty the burden of its lay. So the common ground of the fine arts is the expression of the emotions.

Art a Universal Language

Fine art may well be defined as a species of universal language. The joy, pain, devotion, scorn, patriotism, humiliation, or triumph which the poet felt who wrote the sonnet is felt again by the person who reads the sonnet. Fine art, in other words, means a doing or acting, not on the part of the artist alone, but on the part of the appreciator as well. This is exemplified in *dancing*, which is a form of musical appreciation, and in which the listener becomes very evidently a part of the performance—a co-worker with the composer. Arthur B. Davies says: "When I paint a wave I *am* that wave." True. And it is quite as true that when you look at his painting of the wave *you* are that wave. When he sweeps his brush up over the canvas, he feels himself doing just what the wave is doing—he becomes, as he says, a sort of conscious wave; when you sweep your eye over the lines where his brush has led, you too become a sort of acting, conscious wave.

Ruskin describes a wave as "a flint cave—a marble pillar—a passing cloud." Here we have the same principle applied to poetry. We find ourselves, as we read, living the life of the wave, sharing its bygone past, its rushing present, and its unknown future.

In answer to your question: "What is a wave?" the scientist will tell you that a wave is the result of certain causes and principles; he will show you the materials that compose the wave; and, if your curiosity is still unappeased, he will separate those materials into their elements. He will show you the effects of conditions upon them, and he may continue, showing cause and cause of cause to the beginning of the world; or, in the other direction, he may deal with effect upon effect to the end of it. He always leads you into the relations of the wave to all other things, and always *away from the wave itself*.

The artist, on the other hand, forces your attention *to the wave*, ignoring in his picture the fact that anything else exists. "The real work of art—its way leads nowhere and its frame ends the world." He bends all lines of attention to the thing in hand, fills the consciousness with it, excluding all other things, and uses it as a means of bringing you into the mood which he has experienced.

Fine art brings us into a condition of repose. It leads us, as it were, by making captive, first, our sense of seeing or of hearing or our imagination; and thence, through the unity and intensity of its interest, our whole consciousness—until like the children and the Pied Piper, we forget all else and follow. But even in this repose there is a sort of activity. When we are enjoying a lyric or a musical rhapsody or a symphony of color, we are living as intensely as at any other time, but our life is being led and is simply free of the conscious effort of living.

Hugo Münsterberg, the psychologist, thus defines the mission of art instruction: "To bring into every life the ideal repose, the repose in the ideal; to bring us that rest which is not fatigue from work, nor the rush of amusement; no, rather that rest which is complete satisfaction beyond the struggles of the day, complete harmonization of all our energies, complete fulfillment of our real personality."

A work of art, in order to give this complete repose, must have but one theme; it must be free within itself from conflicting attractions or suggestions; it must, in other words, have *unity*. Whether it be a sonnet, sonata, picture, vase, or cathedral, it must give one impression. That impression may be simple, as is that given by the architecture of the California missions; it may be complex, as is that of St. Mark's cathedral in Venice; but it must be *one*. It may be grand, as in the sculptures of Michelangelo; or it may be delicate, as in the carvings of the Japanese; but it must be an *unconfused* impression. It may be brought about by combining many similar forms, colors, lines, or ideas until they add power to one another, as in some of the poems of Milton—giving that quality which we call harmony. It may be brought about by leading the attention to an unlikeness in certain related things, as in Keat's sonnet 'On the Grasshopper and the Cricket', producing a contrast. But in any case a single impression must result.

Now, it will be clear that Nature does not always exist in perfect harmonies or perfect contrasts. Nature indeed has other business in hand than the forming of perfect pictures. If he would produce pictorial beauty, the artist must make many a change in the "landscape with figures amid which we dwell." He must select, arrange, subdue, and accent the elements of his work, so that they will produce the mood or set forth the idea which he is endeavoring to present. This process of selection and arrangement is technically known as "composition." Let us consider some of the requirements of good composition and the methods by which it is obtained.

How the Eye Takes in a Scene

When, in looking over the fields, we send our glance from the trees to the hills beyond them; when we remove our eyes from a person to whom we are speaking, to the walls just behind him; when, in fact, we leave off looking at any one thing and look at something either farther away or nearer than that at which we were looking before, our eyes change their focus for the occasion in somewhat the way in which the focus of a camera is changed to suit varying distances. The eye, however, is by far the more subtle instrument, and is sensitive to variations of distance which would make no apparent difference to the camera. It may therefore be said that each thing we see in nature is, when it is being seen, the center of a little picture all its own and that it is the sum of a number of these little pictures which gives us our impression of "all outdoors." Now, if the artist were to try to paint in one picture the hills as he sees them when looking directly at them, the trees as he sees them when looking directly at them, the clouds as he sees

HOW ANIMAL PAINTERS DO THEIR WORK

This is a good example of the way in which real artists go about their work. This one wanted to show a deer at rest, as his half-done painting proves; but in order to get the deer just right, he had to set up his easel in a deer park, and then study the deer as it moved about. The study of animal life is one of the many interesting phases of the fascinating work of the artist.

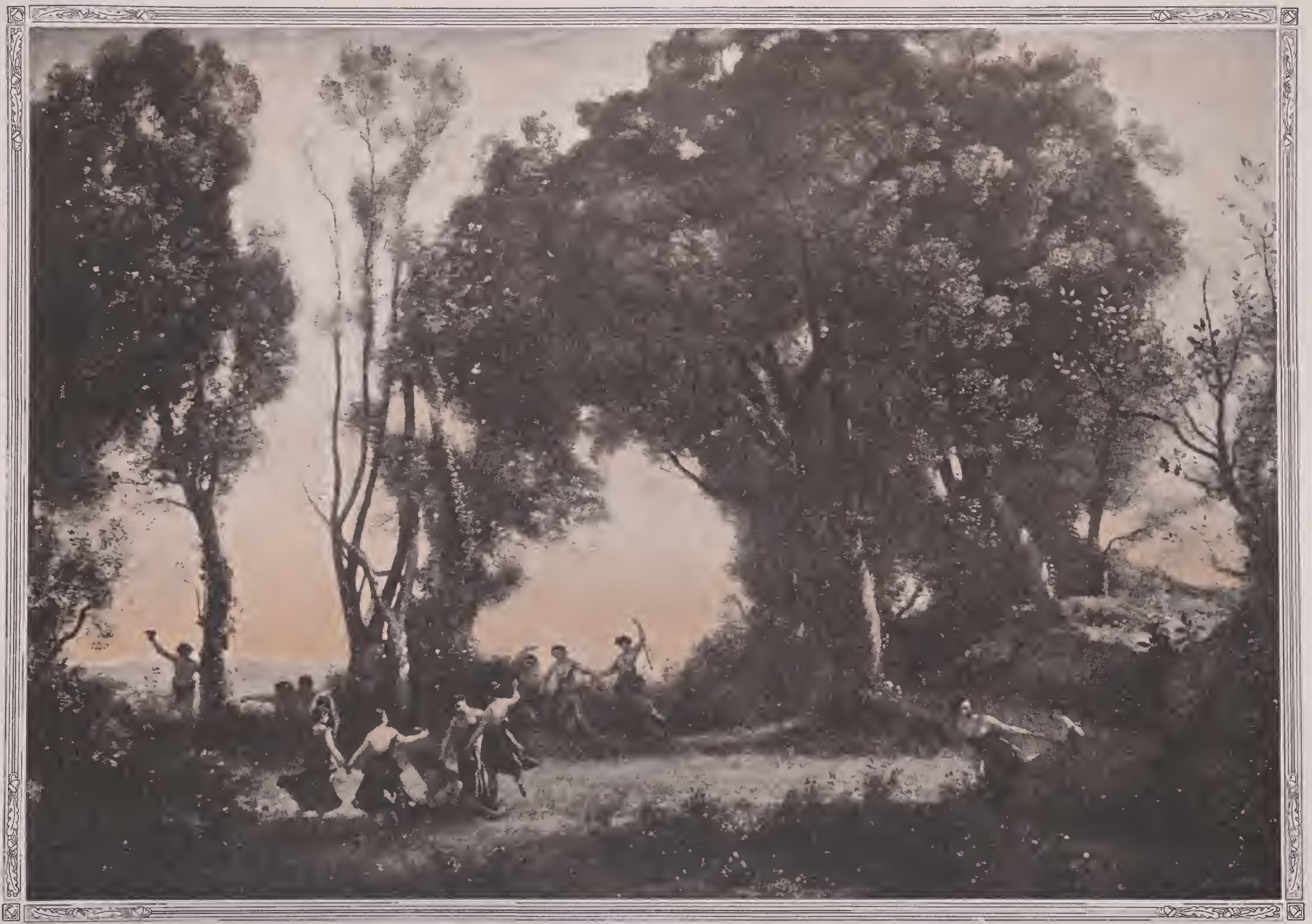
them when looking directly at them, he would have a picture with as many separate interests as it contained objects—a picture which could never have unity or give repose of any sort. So the artist must select some one thing for the main theme of his picture, and to this he must subordinate all other things which may occur in it.

A study of great paintings will show the various ways in which artists accomplish this suppression of the secondary things and emphasis of the important ones. It will show that a figure may be made prominent by the position it occupies on the canvas, by its relations to other figures, by its having a space of comparative quiet around it (notice the effect of the halos around the heads in the old-master paintings of the saints), by the focusing of many important lines upon it or the introduction of a contrast near it, by its being more minutely drawn and finished than the rest of the picture, and by the suppression of other figures or groups of figures through partially hiding them from view, turning them away from the spectator, causing them to look or point toward the principal figure or throwing them into a subdued tone.

In nature it is sufficient if the form of a tree be beautiful against the sky; in a picture the visible shapes of sky seen through the tree must be equally beautiful. The picture, since it is all to be seen at once, must be a beautiful pattern in which every shape involved is fine, the background spots not in any sense being left-overs from the shaping of the motif-parts; rather, being conceived in the same aesthetic spirit which characterizes those parts. The contours which distinguish tone from tone may not fall merely anywhere, but only in such ways that tone and tone and interest and interest shall be fairly held at pleasing intervals. Consistency of character, which has been called harmony, consistency of attractions, which has been called balance, and consistency of movement, which has been called rhythm, will keep all elements of the work together in an integral whole. Here again the artist in forming his work must exercise his aesthetic judgment, varying from nature's appearances, if need be, to bring finer proportion into his work, to give it more perfect unity, and deeper meaning.

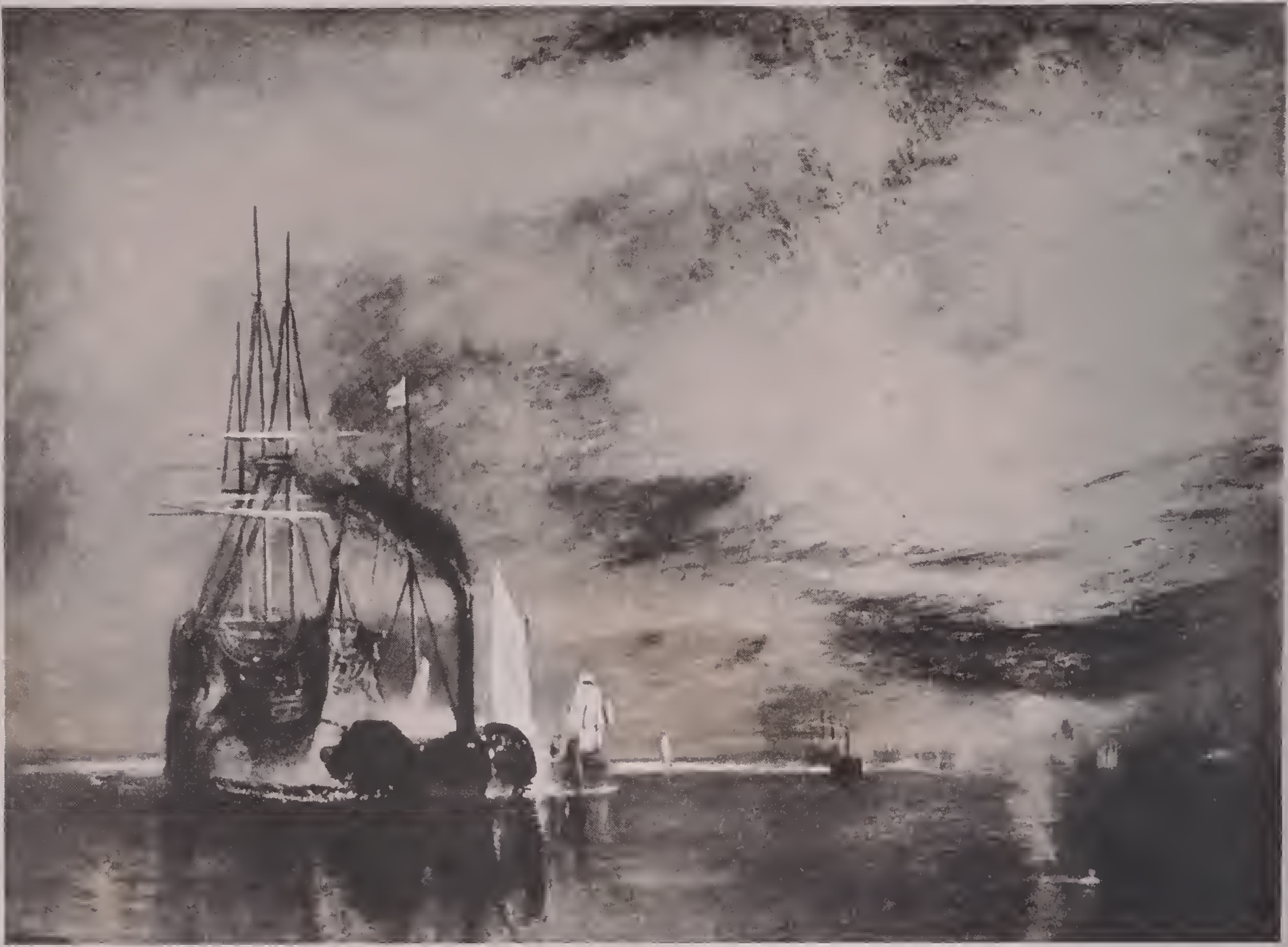
Two Great Paintings

Let us look at Corot's landscape 'Morning'. It has come to be called 'The Dance of the Nymphs'. Is this because there is a group of tiny figures at the bottom—who in truth are scarcely dancing and who may hardly be called nymphs? Or is it because of the witchery of that great movement which takes us from the bottom up into the picture, across the top and down the other side, lastly circling round and round the bit of sky in the center, leading us, before we know it, in an airy dance through the tree-tops? The little figures give the keynote—they form a statement of the theme, Morning, Happiness, Dancing. But even if they were suddenly to whisk themselves out and disappear on the other side of the tangled shrubbery, the movement of the picture would still go on, and it would still be a dance of the nymphs.



The famous painting by Corot, called 'Morning' or 'The Dance of the Nymphs'

A MASTERPIECE THAT BREATHES MELANCHOLY



When you look at the painting, you see an old sailing vessel being towed down a river, and even without thinking about it, you feel somehow that it is a melancholy event. Then, when you remember that the picture is Turner's great work, 'The Fighting Téméraire', and that it shows the "old bulldog" of the British navy being towed down the Thames to be broken up, you catch the full significance of it. In every detail, in the character of the lines and the massing of the shadows, even in the drooping clouds, Turner expresses sorrow that so noble a warrior should come to such an ignominious end. Ruskin said that of all pictures not involving human pain, this work of Turner's is the saddest. It is in this ability to make the very lines and shadows of the picture breathe the spirit of its story that the true genius of art appears.

For a contrasting mood see Turner's great picture, 'The Fighting Téméraire'. What is there about this picture to show us that this ship is the old hero of England's battles that she is—or to tell us that she is being towed away for breaking up? And yet Ruskin says that, of all pictures not visibly involving human pain, this is the saddest. What has the artist done to make us feel the solemnity of this occasion? We see a sheet of still water under a great bending sunset sky. On the other side a tall ship is coming up, towed by a black tugboat. Long ripples are thrown to left and right, and thin smoke pours back from the funnel of the tug. Shadows are gathering from all sides, and there are the buildings of a great city beyond in the gloom. Study the use of lines. Are they like those merry ones that circle round the canvas of Corot's 'Morning'? Or are they the lines which we see in the solemn groves of pine or cypress, in the desert and in the great cathedrals? Are they not like figures in a funeral march? Has the artist accepted nature only as he found her?

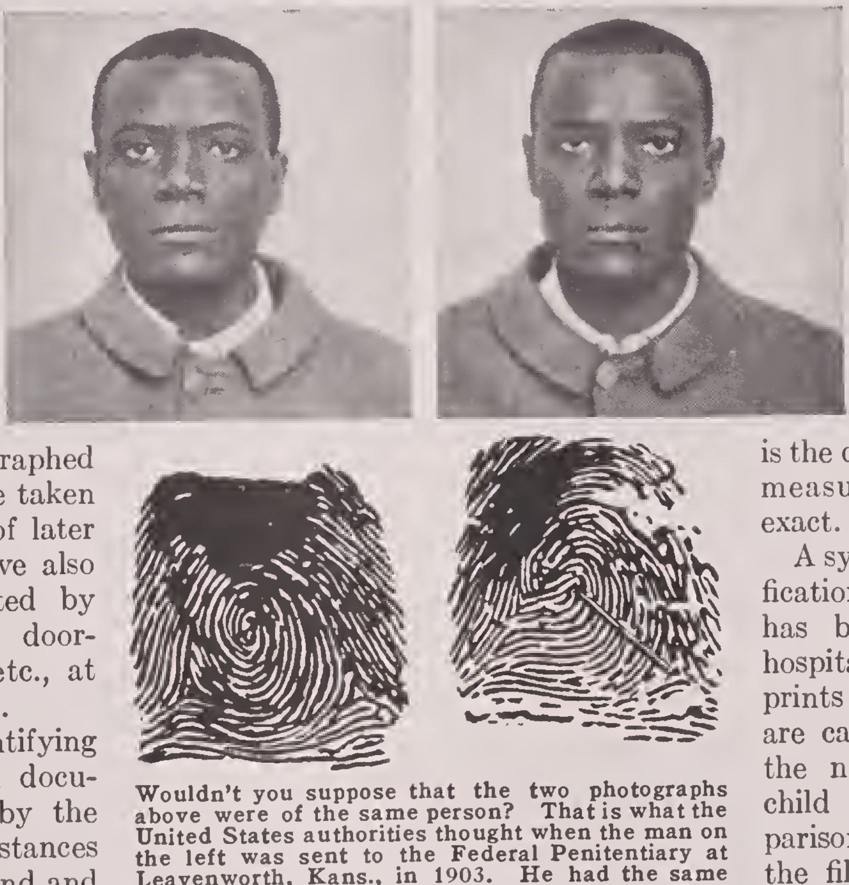
The beauty of a picture or a piece of music does not lie in pleasing the sense alone. Perhaps it is impossible for the sense to be engaged at all without the mind's receiving some deeper message through it. It is this fact which caused us to observe earlier in this article that art is a sort of language. But the message which that language has to deliver is not an intellectual one. It is not primarily for the rehearsing of facts that art exists. The message which a picture has to give, like the message which music has to give, comes to us in the form of an experience, a mood which the work awakens within us—not a story which the thing can tell us. A Bokhara rug may be of "sleepy coloring" and give us the repose of twilight as we contemplate it; a clear melody may give us the same feelings as a view from a mountain-top; a dash of thrilling color may be to us like a battle-hymn. Such are the messages we may receive from pictures and music if we but will, instead of the story that "here is a man and he is doing so and so." These are the feelings which come to us straight from the heart of the artist himself, even though he be centuries in his grave; the tree, the figure, and the incident which the work involves are merely the words by which the message is conveyed.

For some reason music in a minor key is apt to make us sigh. For some like reason certain kinds of lines or movements in a picture give us certain emotions. Perhaps it is because these lines or movements recall associations which stamped themselves upon the impressionable childhood of the race. The ridges of the sea which we call waves and the grander ridges of the continents which we call mountains have had their common origin in the war or play of the elements—in activity rather than in quiet. The risings and fallings of the waves and the mountain ranges, the high straight stems of those still forests amid which our primitive ancestors spent the long days and the mysterious nights, the broad flat reaches of the sea when it is calm and of the desert and of the clouds in a quiet sky—all these things have been seen and watched for ages; nor is it to be wondered that the lines which we see in them have come to call up the same feelings which these things themselves called up.

We have shown the three principal considerations which compel an artist always to turn away more or less from the copying of nature. Of all these, doubtless the last one which we have touched is the deepest, the one determining the trend of the whole work—the consideration of *expression.* Intimately related to that one is the second—the consideration of *absolute beauty;* and the third is that one which deals with the *translation of the three-dimensional aspect of nature into the two-dimensional limits of a picture.* We have spoken of the lines and colors and objects of nature as the artist's alphabet and vocabulary. Were he to devote his time merely to copying the things which nature sets before him, he would be practicing only the handwriting of his art. The considerations which we have enumerated above give him a grammar of art, and the power to express himself.

FINGER-PRINTS. Look closely at the ball of your right thumb. Use a magnifying glass if you have one. You will see that the skin is covered with fine curved lines. Press the ball on an ink-pad and then on a sheet of white paper. This will give you your thumb autograph. No other thumb in the world, not even your own left thumb, will give a print just like that; and the same is true of all your fingers, and everybody's fingers.

FINGER-PRINTS SOLVED THE MYSTERY



Wouldn't you suppose that the two photographs above were of the same person? That is what the United States authorities thought when the man on the left was sent to the Federal Penitentiary at Leavenworth, Kans., in 1903. He had the same name as the man on the right, his bodily measurements were practically identical with his namesake's, and but for the evidence of the finger-prints the confusion might never have been cleared up.

This fact has been put to practical use by police departments of many countries. When a criminal is caught, he is photographed and his finger-prints are taken to identify him in case of later offenses. Criminals have also frequently been detected by their finger-prints on door-knobs, window-panes, etc., at the scene of their crime.

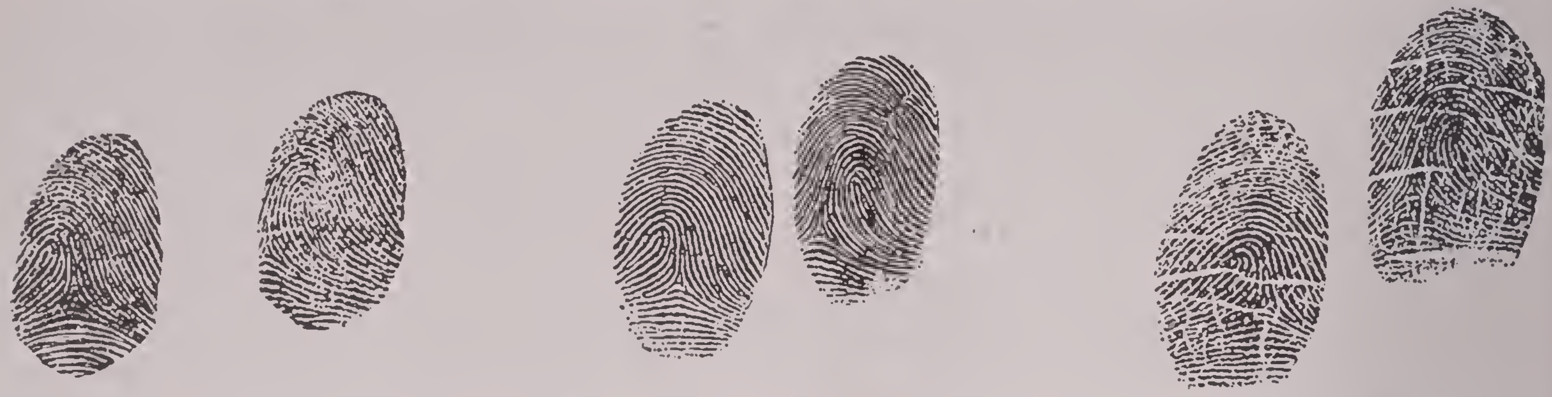
Finger-prints for identifying persons who sign legal documents were first used by the Chinese, and in early instances in the history of England and America, thumb-prints have served as the signatures of persons who could not write. But the system did not come into use for the identification of criminals until Sir Francis Galton, the great British scientist, published in the last part of the 19th century a detailed study of finger-prints. Sir Edward Henry, commissioner of the metropolitan police of London, made this the basis of a filing system which enables an expert to pick out a criminal's record from thousands of others in 15 minutes.

The finger-print method of identification has replaced to a large degree the famous Bertillon system of measurements devised by Dr. Alphonse Bertillon in Paris in 1885. This method depended on accurate bodily measurements, such as the length of arms and legs, and the length, width, and general shape of the head and other parts of the body least likely to change. The objection to this method is the difficulty of making such measurements sufficiently exact.

A system of foot-print identification for very young babies has been adopted in many hospitals in large cities. Foot-prints taken soon after birth are carefully filed, so that if the name tag worn by the child should be lost, a comparison of its foot-print with the filed prints will at once establish its identity. Prints of the feet are taken rather than of the fingers, because the lines of the new-born fingers are too faint.

Finger prints also prove useful in dealing with illiterate members of backward populations, and the United States Army records the finger-prints of its soldiers. Banks and trust companies have also ex-

HOW YOUR FINGER-PRINTS FOLLOW YOU THROUGH LIFE



These three groups of finger-prints are all of the same person, taken at the ages of 26, 44, and 83 (from left to right). Notice how the loops and ridges remain virtually unchanged, even when the skin has been cracked and shriveled by extreme age.

perimented with finger-prints on checks and legal documents, as a safeguard against forgery. They make identification of the signer certain, but the method is too cumbersome to find general favor.

FINLAND. One of the northernmost countries in Europe is the war-born republic of Finland, which is bordered on the east by Russia and on the west by the Gulf of Bothnia and by Sweden. Finland lies between the region where there are eight or nine months of winter with the sun disappearing entirely during December and January, and regions where there are only six or seven months of winter and where the sun may shine through the fogs even on New Year's Day and set the snowy tree trunks glistening. Hills seldom rise above 400 to 600 feet, and it is only in the extreme north that we find the Manselka Mountains, with heights of 3,000 to 4,000 feet. The Baltic margin of Finland is girded by steep cliffs fringed with many rocky islands, including the Aland group of about 80 islands, in the mouth of the Gulf of Bothnia, which once belonged to Sweden.

Finland's rigorous climate has its milder aspects. The summers, with the sun disappearing only for an hour or so or not at all, are so warm that crops ripen in six or seven weeks. The hills are covered with the delicate foliage and white stems of the birches, backed by the dark pines and firs, and the rock-strewn meadows in summer are bright with wild flowers about cheerful red barns and farmhouses.

Finland has been called the Land of a Thousand Lakes, and indeed 11 per cent of the surface consists of lakes. Lake Saima, 180 miles long, is the largest. The forests occupy 63 per cent of the land surface and give the country its chief industries, saw-mill products and wood pulp forming 70 per cent of the exports. Water-power is highly developed. Only eight per cent of the land is cultivated, but another five per cent is meadow. Dairy products and fish are other important exports. Copper and iron are found, and granite is quarried. The area of the republic is 128,000 square miles, and its population about 3,150,000.

The Finns are related to the Turks and to the Magyars of Hungary, and speak a language quite different from their Slavic and Scandinavian neighbors. During the first half of the 19th century there was a great nationalistic revival centering in the piecing together of the ancient Finnic epic, the 'Kalevala', a poem whose rhythm and spirit were closely imitated by Longfellow in 'Hiawatha'.

Until the 12th century Finland was a free country under warlike kings. It was then conquered by Sweden and held under a liberal constitution until 1809, when it was ceded to Russia as a grand duchy. In 1917 the Finns took advantage of the Russian Revolution to declare their complete independence. Since 1906 there has been woman's suffrage, and a considerable number of the diet of 200 members are usually women. The percentage of Finns who can read and write is high, and there is an excellent university at Helsingsfors, the capital and chief city (population, about 187,000).

FIR. Unlike the pine, whose long slender needles are grouped in sheaths by two's, three's, four's, or five's, the short flat needles of the fir tree are single and grow in flat rows on opposite sides of the branches. They are dark green above and light green below. The cones grow erect on the branches. Although the spruces (sometimes called spruce firs) are often included under the name fir, it is better to consider them as a closely related group. The fir is a native of Europe, as well as of North America.

There are many species of firs, usually growing in high altitudes or cold climates and varying greatly in size and appearance. As a whole they are highly prized for their lumber and resin or gums. The silver fir of Europe (*Abies pectinata*) grows in large forests on the French slopes of the Pyrenees and elsewhere, at times attaining a height of 150 feet and a diameter of 6 feet. The silver fir of the American Pacific coast (*Abies grandis*) is even more majestic, frequently towering to 200 feet in height, and furnishing a soft white wood much used for many purposes. The so-called Douglas fir or Douglas spruce of the Pacific coast is neither a fir or a spruce, but a pine. Of the many other smaller species, perhaps the best known is the fragrant balsam fir (*Abies balsamea*) of the northern United States and Canada. It yields the Canada balsam used in mounting microscopic specimens, while its twigs are used as material for the springy beds of campers and its needles to stuff the sweet-scented balsam pillows.

WHAT FIRE IS *and How* IT SERVES MAN

The Flaming Spirit that Man Has Tamed and Trained to Come and Go at His Bidding—Some Queer Kinds of Fire and what Makes Them

MAN'S FIRST MASTERY OF FIRE

Presumably man first acquired fire by finding trees that had been set to burning by lightning, or taking it from active volcanoes. But it did not truly become his servant until he learned to produce it at will by rubbing dry sticks or striking stones together, as we see him doing here.

FIRE. In these days it is hard to realize the awe with which early peoples regarded the "red monster," which they believed came down in magic ways from heaven (*see* Prometheus), and which many of them worshiped as a representative of their gods (*see* Zoroaster). Ancient Greek philosophers conceived that fire, air, earth, and water were the four elements of which the whole universe was made.

It is supposed that the earliest savages obtained their fire accidentally, from trees set ablaze by lightning, or from spouting volcanoes, and that they treasured it carefully in huts and caves. Careful inquiries go to prove that man from the earliest days has never been without fire for warmth and cooking, and for protection from wild beasts in whom it inspires terror. By and by men discovered how to create fire by rubbing dry sticks together and they invented ingenious fire-drills to aid the process. When they began to chip flint to make axes they learned that fire may be drawn from stone, a method which developed into the flint-and-steel of comparatively recent times (*see* Matches). Still later men found out that fire could also be made by focusing the rays of the sun through a glass lens.

The Great Chemist who Discovered the Nature of Fire

But however much human beings turned fire to useful purposes, they remained ignorant of its true character until the great French chemist Antoine Lavoisier investigated, in 1783, the properties of *oxygen*, and laid the foundation for modern chemistry (*see* Oxygen). Popular indifference to great truths was never better illustrated than in Lavoisier's case, for he was condemned in 1794 by the Terrorists of the French Revolution to have his head chopped off on the guillotine. "The Republic has no need of scientists," said the judge, who pronounced this cruel sentence.

Nevertheless before his death Lavoisier had succeeded completely in disproving the old "phlogiston" theory, which held that when any object was heated or cooled it was due to a mysterious substance (phlogiston) which flowed into or out of the object in question, and we know today that ordinary fire is due to the chemical process called oxidation, which means the combination of a substance with oxygen. That is why fires need air to burn properly, and why a flame will go out after it has used up all the oxygen in a closed vessel. Almost anything will combine with oxygen if enough time is allowed. Iron will rust if exposed long to damp air, and that rust is simply oxidized iron. But when the chemical combination is so rapid that it is accompanied by a flame it is called *combustion*.

To start combustion heat is required. The degree of temperature at which any substance will catch fire is called the *ignition point*, which, of course, varies with the condition of the substance, the pressure of the air or the other gases involved, etc. When the savage rubbed two sticks together, he discovered without knowing it that the ignition point of wood is usually quite high, in other words he had to use a good deal of muscle and create a good deal of heat before flames appeared. But the tip of a match is composed of chemicals which, under ordinary circumstances, have a low ignition point. The heat created by simply scratching it once is enough to start combustion.

The ignition points of some vegetable and animal oils are very low. They oxidize so rapidly as to generate a great deal of heat, and if kept in a confined place will spontaneously take fire. Many fires are caused by the spontaneous combustion of heaps of rags, paper, woolens, and other substances strongly impregnated with oil. Coal, charcoal, and green hay stored in large piles sometimes generate heat enough to cause spontaneous combustion.

Thus we see how a fire is started, but what makes it keep on burning? The answer is one of the most important laws of fire. In scientific language it is this: A fire will be self-supporting only when the temperature created by the combustion of the burning substance is as high or higher than its ignition point. Some very hard woods, like ebony for instance, require a great deal of heat to burn them. If you put the end of a stick of ebony in a coal fire it will burn, but when you draw it out, the fire of the smoldering ebony itself is lower in temperature than the ignition point of ebony and the flames will go out.

This principle explains why you can blow out a match. Your breath carries away the heat until the temperature falls below the ignition point of the matchstick. The stream of water from a fireman's hose cools the burning walls of a building with a similar result.

The heat of a fire depends upon the speed with which chemicals combine with oxygen. This speed in turn depends generally upon the quantity of oxygen present. If we take a bit of iron wire and touch a match to it, it will not burn. But fasten the tip of a match to the end of the wire, strike it, and plunge it quickly into a jar of pure oxygen. The wire will catch fire and burn, with bright sparks shooting off briskly (*see* Air).

Fires that Make No Flame

There are two kinds of fire, with and without flame. The presence of a flame always indicates that the heat has first forced a gas from the burning substance, and that this gas in turn combines with the oxygen in the air. When a coal fire flames, it is because gas is being forced out of the lumps of coal. By heating the coal in kilns in the absence of air, so that it will not catch fire, this same gas may be extracted and stored for future use in gas stoves. The coke, which is left after gas is extracted from the coal, burns without flame. In this case the oxygen combines directly with the carbon in the coke without forcing out gas (*see* Gas, Illuminating).

It is the gas given off by the heated wax in a candle which produces the bright flame. To prove this, blow out a candle which has been burning for some time. A thin ribbon of smoke will arise. Pass a lighted match through this smoke an inch above the wick. A tiny flame will run down and light the candle again.

The brightest flames are not always the hottest. Hydrogen, which combines with oxygen when burning to form water, has an almost invisible flame, even under ordinary circumstances. When it is absolutely pure and the air around it is completely free of dust, the hydrogen flame cannot be seen even in a dark room. The scientist who proved this fact had to feel around with his hands to find his burner. We may imagine that he had no difficulty in knowing when he reached it, for the hydrogen flame is one of the hottest of fires (*see* Hydrogen).

The Fire that Makes Gas Engines Go

When an inflammable gas is mixed with air in exactly the quantities necessary for complete combination, it will burn so fast as to create an explosion. This is what takes place in a gasoline engine. The carbureter provides the air mixture and the electric spark sets it on fire. (*See* Gas Engine.) The occasional small explosions after the burners of a gas stove are turned off are due to the same fact. A little gas is left in the pipe, more and more air creeps in through the air valve until the mixture becomes explosive and the tiny flame remaining on the burner thereupon "fires back."

A substance is called *inflammable* when it can be ignited in the air under ordinary circumstances. But what would you say if you were told that air itself is inflammable under certain conditions? All you have to do is to reverse the process of a gas stove. If instead of having gas in the pipes and air outside, you had air in the pipes and gas outside, you could light the stove and cook with it just the same, for the combination of gas and oxygen would be equally effective. So, if men lived in an atmosphere of coal gas, we would be paying to have air piped into our homes for our cooking. Thus, when we say that some things will burn and others will not, we must remember that such a statement always means "in ordinary air."

The history of fire is the history of progress. As men have learned gradually how to tame the "red monster" and make him their servant, they have been able to develop the great forces of nature (*see* Civilization). Fire has yielded them the power of steam; it has extracted the metals from the rocks, the rubber from the gum of a tree, the hard brick from the soft clay. Every factory chimney is a monument to the importance of fire. Every instrument we use, almost everything we eat, all our conveniences, even our ice, owe their existence to fire.

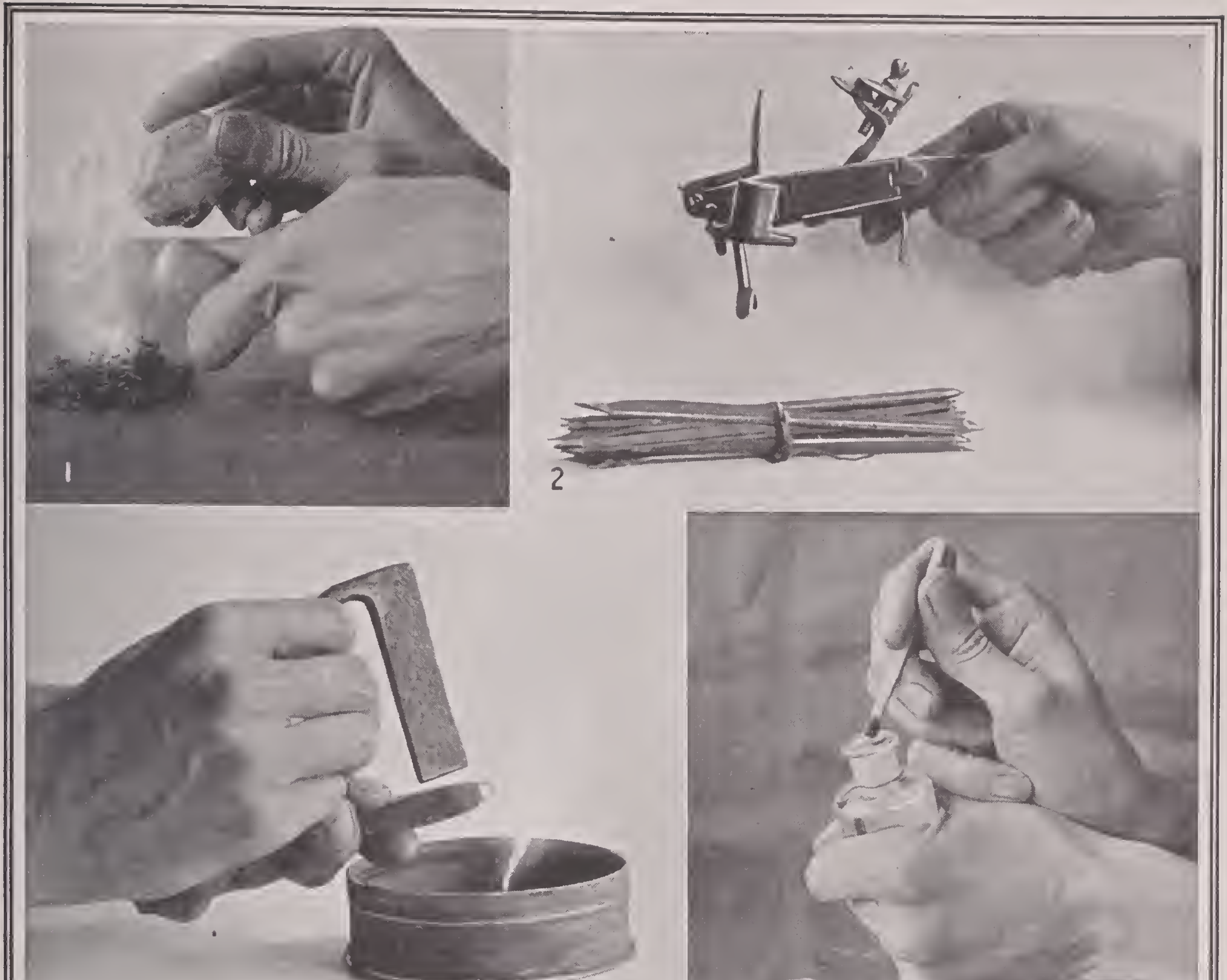
Worship and Legends of Fire

Fire-worship and legends associated with the origin of fire have existed since the earliest times. In many cases fire-worship was associated with sun-worship, and fire was regarded as the earthly representative of the sun-god. A common feature of such worship was the practice of preserving "sacred fires" in the temples.

The Prometheus legend and the religion of Zoroaster, two of the best-known examples of this kind, have already been referred to at the beginning of this article. The latter, known also as Persian sun-worship, is of extremely ancient origin, but persists to this day. When the Parsees fled from Persia to India in the 8th century, they carried with them their sacred fires, which are said to have been kept burning ever since. Other famous examples of the veneration of fire are found in the "sacred flames" of the Vestal Virgins in ancient Rome, and the "fire altars" maintained by the Aztecs.

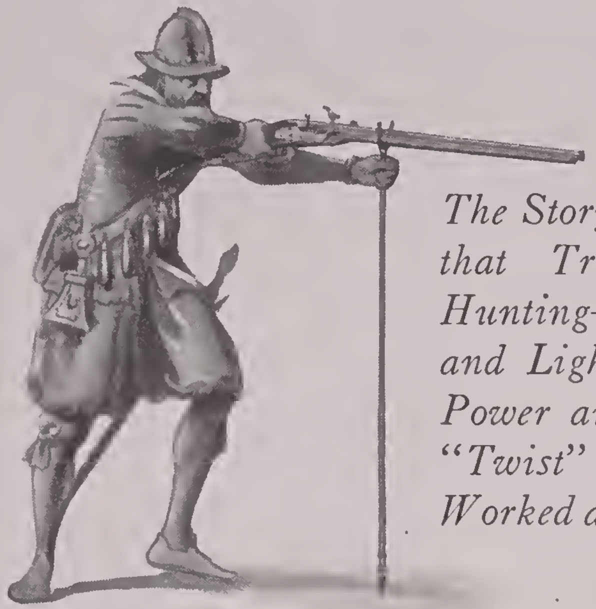
North American Indians attributed the origin of fire to various animals which, according to tribal legends, first showed their far-off ancestors how to make it—the buffalo by striking sparks from stones with its hoofs, and the panther by scratching the rocky hillsides with its sharp claws.

SOME OLD WAYS OF MAKING FIRE



Among the oldest of methods for getting fire is that of striking stones together (1), the spark igniting dried moss or leaves. With one improvement—the use of steel instead of a second stone—this process served man until approximately a hundred years ago. The "fire pistol" (2) shows one of its best developments. The flint was struck against steel when the trigger was pulled, and the sparks ignited inflammable material in the body of the "pistol." The ordinary flint and steel (3) is a less complicated arrangement. Then chemistry came to man's aid with the first match (4). It was tipped with a substance which ignited when the match was dipped in acid. The old "promethean match" (5) used the same principle, but the acid was contained in a tiny vial which was crushed with pliers. The first real match—the so-called "lucifer" or friction match—was invented in 1827, and was ignited by drawing the head through folded sandpaper.

From the ARQUEBUS *to the* AUTOMATIC RIFLE



The Story of the Small Metal Tubes that Transformed Warfare and Hunting—How They Grew Smaller and Lighter while They Gained in Power and Range—The Ingenious "Twist" inside the Barrel which Worked a Magic Change in Firearms

FIREARMS. A rough metal tube about three feet long, closed at one end and fastened to a straight stick, was the first hand-gun ever used. It was loaded through the muzzle with crude gunpowder and bits of stone or metal. One man held the stick braced under his arm. Another applied a fuse or "match" of smoldering tow to a touchhole near the breech. Both said their prayers and closed their eyes. The gun went off with a tremendous roar, a burst of flame, and a great cloud of smoke. If the enemy was not more than a hundred feet away, a few might be wounded; but usually they got off with a bad scare. But the gun was just as likely to blow up and kill the men who operated it.

Now let's look at today's direct descendant of that ancient hand-gun. It too has a metal tube fastened to a wooden "stock" or handle. It too is loaded with powder and bits of metal. The fundamental principles are exactly the same; but see what a difference in its performance! A man lies down, holds the wooden stock to his shoulder, glances through the sights, and presses a small trigger. The weapon starts a sharp *put, put, put!* but there's little flame and no smoke. While you count "one, two," 12 bullets, swifter than sound, have hit a six-foot target half a mile away, penetrating a steel plate a quarter of an inch thick!

Between the 15th century hand-gun and the 20th century automatic rifle stretches an almost infinite variety of ingenious and interesting firearms, developed out of men's keen competition in warfare and hunting. Here we can only trace briefly the mechanical development of the so-called "small arms"—muskets, rifles, shotguns, revolvers, pistols—leaving the history of cannon and artillery which developed earlier than the hand-guns, and of explosives, to separate articles (*see* Cannon; Explosives).

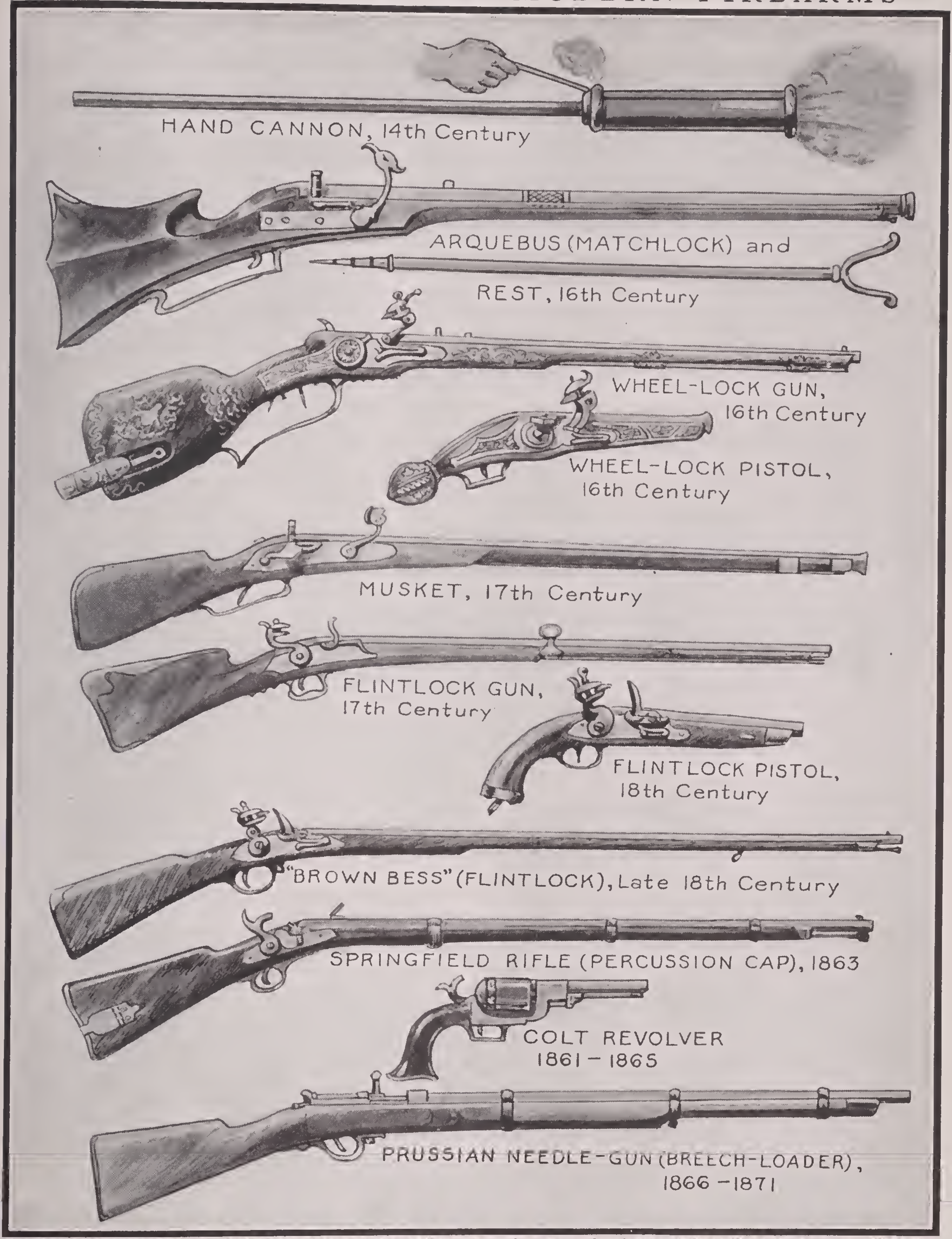
When the first hand-gun was given a curved stock with a wide butt to be placed against the shoulder, it was called a "hackbut" or "arquebus." This was soon improved by fixing a hammer on the gun to hold the taper or match, which was brought down to the touchhole by a trigger. Weapons equipped with this device were called "match-locks." They continued to be clumsy arms, useless in rainy or windy weather, and not nearly so rapid and effective as the long-bow and cross-bow at their best.

About 1540 the Spaniards developed a longer match-lock with a bore a little larger than that of the standard modern shotgun. This was called a "musket," a term which came to be applied to all military hand-guns up to the time of the rifle. The early muskets were so heavy that they required a rest, and musketeers carried long forked rods, which they planted in the ground to hold up their weapons while they fired. They were usually loaded with a single round bullet of lead, which was forced down against the powder with a ramrod.

Early in the 17th century the "flint-lock" was invented, which made the burning fuse or "match" unnecessary. The hammer, operated by a spring, had a head like a vise which held a piece of flint. Around the touchhole on the side of the barrel was a priming pan with a hinged cover, which had an upthrust wing of furrowed steel. When the trigger was pulled, the hammer fell and the flint struck the winged cover and opened it, sending a shower of sparks to fire the powder in the pan beneath. The flashing of this priming powder through the touchhole set off the charge in the barrel and fired the gun.

The flint-lock musket was the constant companion of the early American colonists. With its aid, and with the shorter bell-mouthed "blunderbuss"—the forerunner of the shotgun—the Puritan fathers supplied the family larder with game and overcame the Indians. This type of musket was the "Brown Bess" of the British infantry for more than a century, and

THE FAMILY TREE OF MODERN FIREARMS



Five hundred years of firearm history are shown above, and we notice four great developments from the original "Hand Cannon." The "Hand Cannon" was just a tube, ignited with a red-hot iron applied to the "touchhole," and supported by holding the stick under the arm. The Arquebus changed the stick to a stock held against the shoulder, lengthened the tube, and provided a mechanism for applying a burning "match" by pulling a trigger. It was supported on a metal fork. The next six weapons, including the famous "Brown Bess" of Wellington's armies, used the flintlock for firing. The Springfield gun of Civil War days introduced rifling and percussion cap ignition, which was also followed by the revolver. The Prussian Needle-Gun established breech loading.

the arm of the "Minute Men" at Lexington and Concord and Bunker Hill. With it were fought the battles of the French Revolution, the Napoleonic wars, the War of 1812, and many another great historic struggle.

A Scotch clergyman named Forsyth first patented the use of fulminates for firearms in 1807, and during the first half of the 19th century the percussion cap for igniting the powder slowly replaced the flint-lock. This system depended on the fact that certain explosives, called fulminates, are set off when struck a sharp blow. In percussion cap guns a nipple was set perpendicularly in the breech and on this was placed a small copper cap containing the fulminate. The cock or hammer, when released by the trigger, struck and exploded this cap, sending a jet of flame into the powder chamber. Percussion-cap guns were the chief infantry weapons on both sides in the American Civil War.

The Frontiersman's Deadly Rifle

But the old musket had always suffered from two great defects. The round bullets had to be of large diameter or caliber to get the required weight and striking force, and hence the air resistance slowed them down very rapidly. Also, they were set to rolling as they passed out of the smooth-bore barrel, which made them "curve" like pitched baseballs, so that accuracy was impossible beyond a hundred yards.

To overcome these defects the principle of rifling was adopted. This consisted of cutting spiral grooves or ridges inside the barrel to grip the bullet as it passed through and give it a corkscrew spin. The rifling put an end to the erratic flight of the balls, and eventually permitted the use of long cone-shaped bullets, giving the projectile greater weight without increasing the air resistance. The spinning motion kept the points of such bullets forward, instead of allowing them to turn end over end as they would have done if used in the old smooth-bore guns.

Although the principle of rifling was discovered in the 16th century, no great use was made of it for 100 years. Peter and Henry Leman of Lancaster, Pa., were the first to make rifles of a short German pattern in America. Not until the idea was developed into the long small-bore guns of the backwoodsmen of the American colonies, including such men as Daniel Boone, did the rifle become a truly effective weapon. In the War of Independence the British learned to their sorrow of the long range and deadly accuracy of such rifles in the hands of Virginia and Kentucky pioneers, and the lesson was carried back to Europe.

The rifles of these early frontiersmen were loaded from the muzzle with round bullets wrapped in a "patch" of greased linen or buckskin, to make the bullet fit the rifling more closely. Even so, it was a slow process to force the bullet home down the grooves and the smooth-bore musket with its loosely fitting ball continued to be the chief military weapon for this reason. As for the cone-shaped bullet, the increased friction of its long sides made its use next to impossible in the muzzle-loader, until the invention of the famous Minié ball (adopted about 1852, in Europe), which fitted loosely at loading and expanded to fit the rifle grooves when fired.

But it was not until the breech-loading principle came into use that the rifle could rival the smooth-bore in speed of operation. In 1810 John H. Hall, an American, had invented a breech-loading flint-lock rifle, with a hinged chamber at the breech which tilted upward to receive powder and ball, and then dropped down opposite the opening of the barrel. This device, however, allowed a great leakage of powder gases, as did the revolving-cylinder rifle invented in 1836 by Samuel Colt, the father of the modern revolver.

The first successful military breech-loader came with the use of cartridges, which contained in one paper package the powder and the bullet, and so could easily be inserted in the breech after tearing off a corner with the teeth to expose the powder to the fire from the percussion cap. The Prussian "needle-gun" was among the earliest military types of cartridge-firing breech-loaders, and with it the Prussian armies were able to overwhelm the Austrians in 1866.

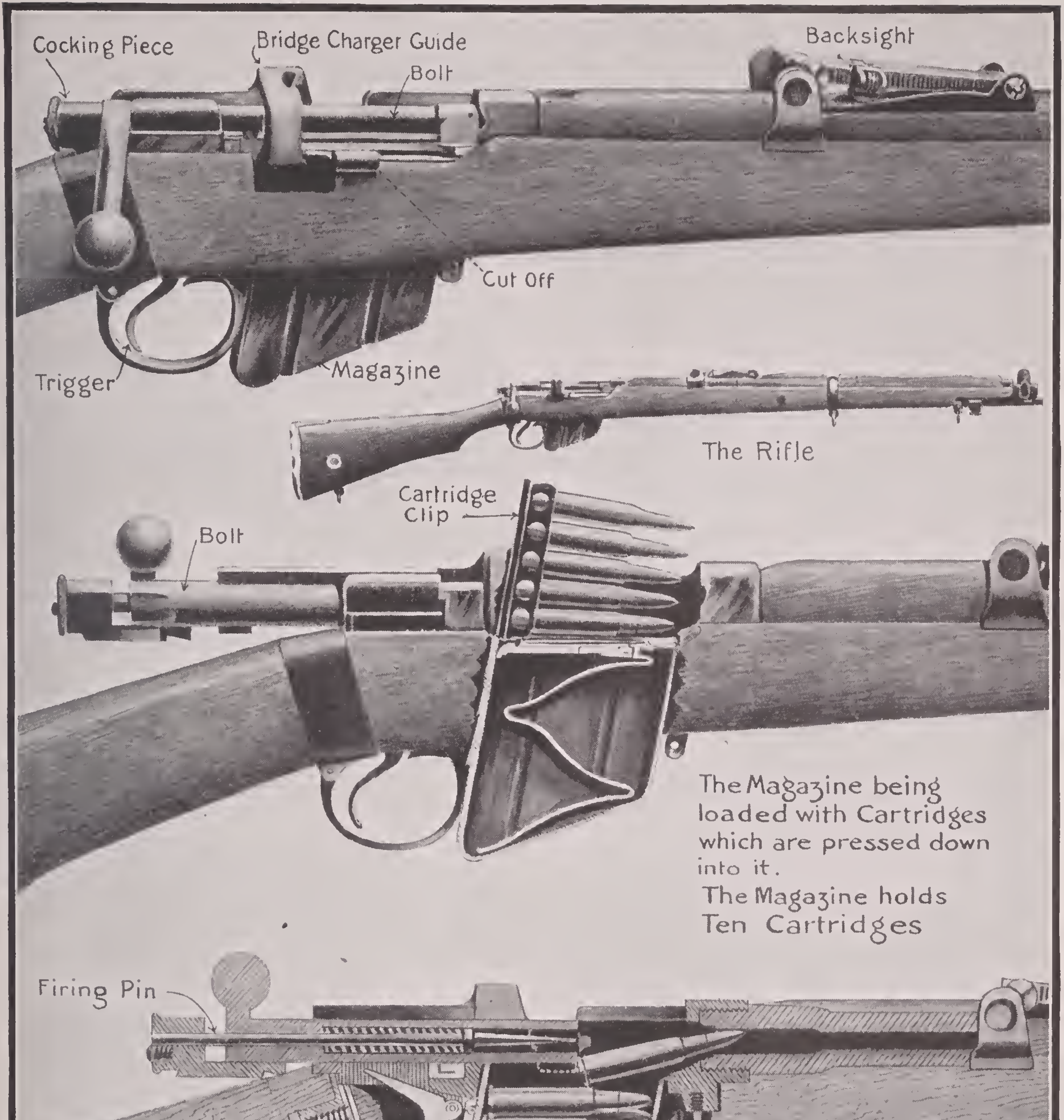
The adoption somewhat later of copper and brass cartridge shells stopped virtually all gas leakage at the breech, for the shell expanded on explosion, tightly sealing the breech opening. The "Old Reliable" Sharps buffalo-gun and the Remington were among the most famous of the early sporting rifles using this principle. The United States Army "Springfields" (model 1865) were produced by altering the "cap-and-ball" model of the Civil War to breech-loading cartridge rifles, which continued in use as late as the Spanish-American War.

The first metal cartridges were of the "rim-fire" type, that is, they were exploded by a blow of the firing pin on the outer rim, beneath which was the fulminate. These were soon displaced, in all except the smallest calibers, by the "center-fire" cartridges of today, in which the cap occupies a small pocket in the base of the brass shell.

Ejecting the Empty Shells

The breech mechanism of cartridge guns was early equipped with an ejector which cast out the empty shell when the weapon was opened for reloading. It was a simple step to add a magazine in which several cartridges could be placed, with a device for bringing them successively into proper position in the firing chamber, so that as fast as one was fired and ejected, another would be thrust in. This gave us the various types of repeating rifles, some with tube-magazines running up through the stock (like the Spencer rifle), or fastened beneath the barrel (like the old Colt "pump-gun" or the early lever-action Winchester models). Others had box-magazines of the Mauser type in which the cartridges lie one above the other in a compartment at the breech. The latter method, combined with the bolt action, prevails in nearly all modern military rifles, such as the Krag-Jorgensen,

HOW A MODERN ARMY RIFLE WORKS


Cocking Piece
Bridge Charger Guide
Bolt
Backsight
Cut Off
Trigger
Magazine
The Rifle
Cartridge Clip
Bolt
The Magazine being loaded with Cartridges which are pressed down into it.
The Magazine holds Ten Cartridges
Firing Pin
Bolt being pushed forward carrying the topmost cartridge into position for being fired

The distinguishing feature of virtually all military rifles of today is the bolt action and magazine loading. Here we see the English Enfield rifle which was temporarily adopted by the American forces during the World War. At the top the details of the breech are shown. Beneath is the complete rifle. The middle picture shows how the ten cartridges are loaded into the magazine, five at a time in clips. At the bottom you see the bolt as it moves forward thrusting a cartridge into the chamber.

.30 caliber repeating rifle used in the United States army from 1892 to 1903.

Deadly at Three Miles' Range

It remained only for the arrival of smokeless powder to bring rifles to their present height of shooting power (*see* Explosives; Gunpowder). The increased pressure of the new powder, however, caused the old soft lead bullets to jump the rifling, and so brought about the invention of the hard metal jacket for bullets. This jacket, composed of steel or of an alloy of copper and nickel, gives the bullet so secure a hold on the rifling that a much sharper twist is given, imparting to the bullet a much more rapid spin. This, in turn, makes possible the use of longer and narrower bullets, which can be driven to great distances at tremendously high speeds. The new Springfield service rifle of the American army, for instance, shoots a bullet of .30 caliber (30/100 of an inch in diameter) with a muzzle velocity of 2,700 feet per second. It is recognized as the best army rifle in the world, for it is extremely accurate for more than a mile, and has a maximum killing range of three miles; at 300 yards the sharp-pointed "spitzer" bullet will pierce half an inch of steel. But when the United States entered the World War in 1917, the necessity of equipping over 3,000,000 men with rifles led the government to adopt the British Lee-Enfield rifle which could be obtained in quantities, and re-chamber it for American ammunition under the name "U.S. model, 1917 type."

The full metal-jacketed bullets used in military cartridges are not suitable for big-game hunting, for the small clean wounds which they usually inflict have not sufficient *stopping-power*. To overcome this defect, soft-pointed or dumdum bullets are used, in which the hard metal covering extends only part way down the sides, leaving the leaden point exposed. Such bullets spread out or "mushroom" when they strike, causing wounds which bring down the game more quickly. By common agreement among civilized nations, the use of dumdum bullets is forbidden in civilized warfare, as is the use of explosive bullets.

The crowning achievement of rifle construction is the self-loading weapon, commonly called the "automatic." In these guns the recoil is used to operate the mechanism, so that the cartridge is fired, ejected, and another put in its place by the simple movement of pulling the trigger. A true automatic rifle, operated on the machine-gun principle, firing 40 shots in a stream without the necessity of pulling the trigger for each shot, was adopted by the American armies and used with success toward the close of the World War of 1914–18 (*see* Machine-Gun).

History of Pistols and Revolvers

The early pistol was simply a gun small enough to be fired with one hand. Its development followed step for step that of the musket. From the huge "horse-pistols" nearly two feet long to the tiny vest-pocket weapons of the "derringer" type, they passed through the same stages as their larger relatives—flint-lock, cap and ball, and cartridge. Many were double-barreled, while the "pepper-pot" variety common in Civil War days had from four to eight barrels arranged in a circle. The highest development of these early side-arms was achieved in the duelling pistols, which were often richly adorned with silver, gold, and jewels, and were made with watchlike precision. None of the smooth-bore pistols were of much use except in hand-to-hand fighting. The horse-pistol carried by cavalrymen was often employed as an effective club after it had been fired once at close range.

The first great departure in pistol-making came with the invention of the revolver. The principle of the revolving cylinder containing six charges of powder and ball which could be fired in rotation through the same barrel had proved unsuccessful in the Colt rifle mentioned above, but won instant popularity when applied to the smaller weapons. The Colt revolver of the cap-and-ball type which came into use during the Civil War was soon replaced by the .45 caliber cartridge "six-shooter," which achieved everlasting fame as the constant companion of plainsman and miner of frontier days.

The double-action (self-cocking) revolver, in which the hammer is cocked and released and the cylinder rotated by a single pull on the trigger, soon took the place of the single-action weapon, which had to be cocked by hand. This weapon, firing smokeless powder cartridges with "soft-point" bullets, has become a standard pocket arm.

The self-loading or automatic pistol, however, bids fair to replace the revolver entirely in military and private use. Capable of firing from eight to ten shots with extreme speed, it is superior in mechanical principle to the revolver, for in the latter there is always imperfect alignment and gas-leakage at the junction of the barrel and the revolving cylinder.

Shotguns, Ancient and Modern

As early as 1580 fowling pieces seem to have been made for the purpose of shooting at flying birds. Blunderbusses, with yawning barrels loaded with small shot or bits of metal and stone, were used as "scatter-guns" in battle, or for defending stage-coaches from highwaymen. Out of these grew the modern shotgun, whose development followed closely that of the musket and rifle.

Modern shotguns have barrels ranging in size from 8-gage to 24-gage, a system of measurement which has come down from the days of the musket. The standard 12-gage gun, for instance, is one whose barrels are large enough to accomodate a round leaden ball of such a diameter that 12 of them would weigh a pound.

Shotgun cartridges for breech-loaders, usually made with a brass base and paper sides, may be loaded with any size shot, from the tiny pepper-shot used on small birds to the heavy buckshot with which deer and other large animals are killed. Although chiefly a hunting weapon, sawed-off shotguns with buckshot cartridges form part of the equipment of express messengers and others who have to guard large sums of money from robbers, and are also employed by foreign criminals in crowded city districts. During the World War some use of the same weapons was made by American infantrymen in trench raids.

"Choke-boring," by which the barrel is made slightly narrower at the muzzle, causing the shot to fly in a closer group and thus be more effective at long range, is the chief device which has improved the shooting qualities of these guns since the days of the old fowling pieces. The standard double-barreled shotgun is often made with one "choked" barrel and one open. Single-barreled pump-guns and self-loaders have also been successfully developed. The average working range of shotguns is from 15 to 40 yards, depending on the shot and powder used.

Through Flame and Smoke with the FIRE FIGHTERS

FIRE DEPARTMENT. Do you know how quickly a fire company can get to a fire? You ought to be in a city engine-house some night when an alarm is turned in. It's like a cavalry charge on a battlefield. A man sits at a desk under a gas jet. Another man is reading. This is the night watch. The big motor engine's shining brass trimmings wink in the light. Overhead, the firemen are asleep, half-dressed, in a big room full of cot beds. Stout poles set in big rubber pads go up through manholes to the upper floor. You wonder what these are for.

Suddenly the brass gong strikes 4–2–1. That is the "forward charge!" for that engine house. "Turn out!" shouts the man at the desk. But everyone has turned out. The firemen drop through those holes and slide down the poles. They button their coats as they run. The night watch thrusts a torch into the kindlings under the engine boiler, and with a *clang!* and a roar away goes the ponderous automobile engine on its errand.

Men spring to the hose-tender, slipping into rubber coats and helmets as they run. If it or any other of the apparatus is horse-drawn, the touch of an electric button unhitches the horses in their stalls and they leap into their places. The harness drops from the ceiling to the horses' backs, and *snap, snap, snap,* go the harness buckles, under a dozen pairs of hands. The driver springs to the seat and gathers up the reins. Within a few seconds everything is ready.

With a pounding of hoofs the big horses are off after the motor engine. *Clang! Clang!* ring the bells. Clear the streets, get out of the way! The desk sergeant has shouted the number of the box the alarm came from, and all make straight for that corner. The person who sent in the alarm, or a policeman who stands there, tells the crew where the fire is. In a few minutes from the alarm the hose is screwed to a water hydrant and the engine is pumping water into the burning building.

The first thing to be saved in a fire is life; the second, property. The hook-and-ladder truck is there as soon as the engine and hose-cart. Firemen run up stairways and ladders to make sure that the people are all out of the burning building. If they hear a scream or a moan, they break down doors and go right through flame and smoke to the rescue, saving lives, with no thought of their own danger.

One fireman can bring down four people at once on a long shaking ladder. He can hook two children to his belt, and bring a mother and baby on one arm. Back he goes into the flames! This time he brings down a 200-pound man, overcome with smoke. Firemen creep along dizzy window ledges where you would think a cat could not go. They climb on roofs and drop through skylights. They make bridges across alleys and courts with ladders; they hang over roof cornices. Firemen every day do deeds of daring that you would think impossible.

These brave fire-fighters are often killed, or injured for life. Burning shutters, cornices, and awnings fall upon them. Sometimes a roof falls in with them, or an explosion blows up a building. In winter the water freezes as it falls on them, so that often the boots and gloves of the firemen are frozen and have to be cut off. Sometimes a fire company has to stay out 36 hours. Firemen never leave a spark, as careless campers often do, to start a new fire.

No matter how long they have been out fighting a fire, when they get back to the engine house the horses must be rubbed down, fed, and watered, the engine must be cleaned, the fire raked from under the boilers, and another fire laid ready for instant lighting. Only then can they wash themselves, eat, and go to bed.

WHEN THE ALARM RINGS!

Even before he is fully awake, the fireman is tumbling out of bed. The next instant he has drawn on the boots which are already thrust through the legs of his trousers. A second later, his belt is buckled and he is sliding down the pole in the corner to the floor of the engine house below. Coat and hat are donned after the engine has left the building, for even at night the engine is often on the way in less than one minute from the first tap of the warning gong.

It is very important that the fire-fighters reach the fire quickly. In the early days messengers ran through the streets calling "Fire!" or a central alarm bell was rung, as is still done in villages and small towns. The volunteer fire-fighters tumbled out helter-skelter, and much time was lost in finding out where the fire was. Then cities were divided into districts, and when the fire-bell rang a man on a high tower indicated, by flags in the daytime and by lanterns at night, in which district the fire was. Later electric telegraph signals were used, and bells in the engine-houses rang the number of the box from which the alarm was sent.

In a modern system the engine-houses in the various districts of the city are connected by telegraph with a central room at the fire department headquarters. A chief operator or his assistant is always on the watch in this central room, which is the nerve center of the entire system. Fire alarm boxes, painted red to attract attention, are located on street corners, and each box is connected by telegraph circuits with a large instrument board placed in this central room.

To give an alarm, a person pulls open the door of the nearest fire box. This sets a gong ringing, which is the "telltale bell" to guard against the sending of false alarms by mischievous persons, "just to see the engines run." Then the sender pulls down a small lever in the box and releases it. This starts a telegraph instrument inside the box, which ticks out the number of that particular box, indicating it on the instrument board at headquarters by the flashing of a light and the ringing of a small bell. The signal is repeated several times to avoid error. In drawers near at hand are small metal disks, one for

"IT'S A BIG FACTORY OVER ON GREEN STREET!"

The man at the blackboard records orders and alarms, and often can tell the men their errand, as they come sliding down the pole from the floor above.

SLIDING TO SAFETY

Firemen learn to use their belt and rope so well that they can carry 400 pounds in addition to their own weight in a descent to the ground.

each box, numbered to correspond to the street box numbers and arranged in order. The headquarters operator selects the disk bearing the number of the box from which the alarm was sent and places it in a slot on a large telegraph instrument; and this in turn immediately ticks out the number over circuits leading to the fire stations concerned.

In each of the fire-stations a little bell called a "joker" taps off the signal and within 90 seconds or so the company is on its way. A number of companies may have received the call, and while one or more dash off at once, the others hold themselves ready to answer subsequent calls if the fire proves to be a large one. In the case of a very bad fire, all of the companies in the city may be called out.

A single false alarm turned in by a foolish or mischievous person may cost the city a hundred dollars or more. A succession of them may help to produce carelessness, or decrease that efficiency which is the pride of every great department.

Many of the modern fire departments had their beginning in the little volunteer bucket brigades of the early days. With the growth of cities and the development of complicated apparatus for fighting fires, it became necessary to have paid and specially trained firemen. Firemen are chosen because of their courage and mental alertness, as well as their physical strength, endurance, and agility. The recruits are trained and disciplined somewhat as soldiers are; for they must learn to work together efficiently under their officers. Each fire company has a captain and lieutenants, and the companies are usually grouped into battalions under battalion chiefs. At the head of the whole city organization are the fire chief and his assistants. Besides engines, hose-carts, hook-and-ladder trucks, and the like, many cities have powerful fire-tugs for fighting fires along the waterfront and among the harbor shipping.

Machines for extinguishing fires were in use in very ancient times. Large squirts or syringes worked by hand were used at first; and later hand-pumps with hose attached were placed on wheels to be drawn to the fires: they pumped water from nearby reservoirs. The largest of these hand-pumps required 40 or 50 men to haul them to the fires and operate them. Then steam fire-engines were invented, which were drawn to the fire first by horses and later by motors. The motors which take the apparatus to the fire may also be used to pump the water from cisterns or reservoirs. In the modern city water systems the water is often distributed under sufficient pressure by the waterworks to give a powerful stream when a hose is attached from the hose-cart directly to the

WHEN ALL ELSE FAILS—THE NET!

Firemen are always thoroughly drilled in the use of their last resource for saving life from a burning building—a net in which they catch people jumping from the upper stories. Here you see a fireman playing the perilous rôle of the victim to give his mates practice.

THE TWENTIETH CENTURY "RESCUE SQUAD"

Equipped with oxygen helmets, these men rush into smoke-filled buildings to rescue people who have been overcome. They also have a pulmotor, shown in the foreground, with which to revive smoke victims.

fire hydrant. Modern fire departments are also equipped with "chemical" engines which throw streams of fire-extinguishing liquids and gases sufficient to put out small fires.

The modern fire department is concerned with fire prevention as well as fire fighting. Men from the department make regular inspections to see that fire prevention regulations are obeyed. Buildings in thickly settled districts must be of materials classed as fireproof. Burnable waste must not be allowed to accumulate in buildings and alleys. Watch is kept against the careless use of matches, and over the storage and use of inflammable and explosive materials. Fire escapes and exits must be kept ready for use, and automatic sprinkler systems, fire hose, and chemical apparatus must be provided in large buildings and plants. Such regulations have greatly reduced fire damage in large cities.

How We Can Aid in Fire Prevention

EVERY one of us can aid our brave fire-fighters. We can do little when a fire is once started, but there are many things we can do to prevent the terrible conflagrations that take such a toll of life and property every year. Imagine a city of more than 200,000 people—such as Denver, Colo., or Columbus, Ohio, or Providence, R.I.—being completely wiped out each year, while 2,000 of the population are killed and 5,000 injured in the flames. This represents the annual toll paid by the United States to the red monster. In round numbers the property loss is about $225,000,000 a year—ten times the amount, in proportion to population, in European countries. This loss and the cost of the fire departments fall on all the citizens of the country in the form of taxes and higher prices for rentals, goods, and services. The average family thus loses about $30 a year through fires.

By far the greater number of fires are preventable, since they are caused by carelessness. Here are some of the things to remember in the way of fire prevention:

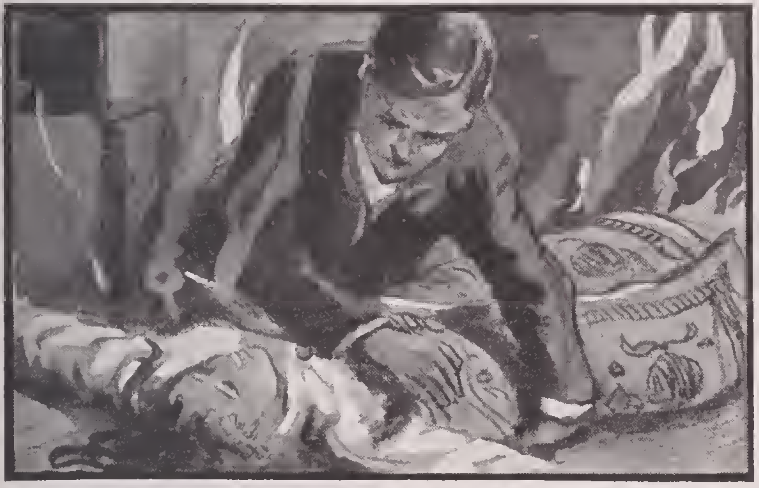
Never drop a match. Even if it is unlighted, someone may step on it and set it on fire. Keep matches in covered metal or china boxes, away from children and mice. Mice sometimes bite match-heads and set whole boxes on fire. Be careful with fire-crackers. They often explode in rubbish, under wooden steps, and on women's dresses. Don't build a bonfire or play around one unless some grown person is watching. Don't leave little children alone in a house or a room with an open fire or a lighted lamp, or with matches in reach. If you build a camp-fire anywhere be sure it is out, and not a hot coal left in the ashes, before you leave the place. Forest and prairie fires that have swept away whole towns have been started in that way. Don't allow loose rubbish in basements and closets. Don't use gasoline, kerosene, naphtha, benzine, alcohol, or turpentine in a room with a fire, or keep these things stored in a house. Don't try to start a fire with any of these, or fill an oil stove or lamp while it is burning.

Use a deep kettle, only partly full of boiling fat, for frying doughnuts. Don't force your furnace in cold weather. Overheated chimneys cause fire. Test your gas pipes and burners often, but don't look for a gas leak with a lighted match. If you can't find it with your nose, send for a plumber. Don't light lamps or gas jets near lace curtains. Watch a grate fire, or put a fender before it. Coal snaps out sometimes. Be careful of punk and incense sticks. Don't put lighted candles on a Christmas tree. They look pretty, but they are dangerous.

RULES ALL SHOULD KNOW ABOUT FIRE PREVENTION

1. Frequent fire drills should be held in all schools to insure order when a real fire breaks out.

2. Unprotected matches often bring disaster. Have a safe place for matches and keep them there.



3. Wrap a blanket about a person whose clothes are ablaze.

4. Unwatched children have no business playing with bonfires.

5. Throw a mattress on burning kerosene or gasoline.

6. Don't look for gas leaks with a match or a candle.

7. In a burning building good air can be found near the floor when the smoke above is suffocating.

8. Always make sure that camp fires are out, down to the very last spark, before departing.

Here are some "do's" to remember about fire:

When you move into a new neighborhood, find out the nearest fire alarm box, the first thing. It will be painted red, and may have a red light above it at night. Ask a policeman how to send in an alarm. If you have a telephone, put down the number of the nearest engine-house and police station, so you can call for help if you can't get out of a burning house. Study all the possible ways of getting out of a house. If it is a tenement or apartment building, with a fire escape, see that the escape is kept clear. If other tenants block up the escape, tell a policeman and have it stopped.

Is Your Child Safe in School?

See whether the school is safe, and has fire drills. If not, parents should refuse to send their children to it, and should arouse public feeling about it, so that the school will be made safe. The doors should open outward with a push, and should never be locked in school hours. The stairs should be wide and shallow, and the treads laid on iron or cement. If a schoolhouse is two stories high there should be iron fire-escapes from halls, marked in big letters, and with a red light that can be seen through smoke. The basement floor should be of cement, and there should be no rubbish closets, even for the janitor, under stairways. Hot ashes should never be emptied near wood. Chimneys should be examined and cleaned every year. The furnace should be in a separate building if possible. And there should be frequent fire drills. A big building of 24 rooms and nearly 1,200 pupils can be emptied in a minute and a half if everyone is properly drilled.

When you go to a theater, public hall, or church gallery, or if you work in a department store or factory, look about until you find the sign "exit" marked by a red light, nearest you. If you are staying in a hotel, locate the stairways, the elevator, and the fire-escape from your room. If a fire starts, make your way out quietly. Don't scream or push in a crowd. A panic is easily started, and more people are killed by falling and being trodden on than by the fire. Help old people and children.

A small fire can be smothered. You know fire cannot burn without air. If your clothing catches fire, roll yourself in a rug or heavy bedclothes. If out of doors, roll on the ground. A boy's or man's thick coat will often put out a small fire. Pull down a blazing curtain and smother the flame. Throw a mattress on a burning floor.

If You're Caught in a Burning House

If you are caught in a burning house, get out if you can without going through flames and smoke. The best air is always near the floor, so it is better to crawl. If you cannot get out, close the doors between you and the fire, go to a window, open it, and stand there and scream for help. Then wait for the firemen. Don't jump. You can lower yourself from a second or even third story window by means of a rope made by tearing sheets in wide strips, knotting them together, and tying one end to a heavy piece of furniture or other support. You can let a child down by such a rope.

Great fires which nearly wipe out whole cities have become increasingly rare, as better methods of fire prevention and fire fighting have prevailed. But formerly fire was one of the great scourges of large cities all over the world.

In 1666 the Great Fire of London lasted three days and consumed buildings on 436 acres, causing a loss of approximately $50,000,000. In Moscow 18,000 houses were burned in 1752. One of many fires in Constantinople occurred in 1729, destroying 12,000 houses and 7,000 lives. Copenhagen was nearly destroyed in 1728, and in 1842 a fire lasting for 100 hours destroyed more than 4,000 buildings in Hamburg, Germany.

One of the most devastating fires in the United States was the great Chicago Fire of 1871, which consumed buildings covering more than 2,000 acres, representing a property loss of $185,510,000. More than 200 lives were lost and 98,500 people were homeless. In the following year, fire destroyed the richest section of Boston. At an earlier date, in 1849, 15 business blocks along the river front of St. Louis were burned, together with 23 steamboats. In 1866, half of the city of Portland, Maine, was ravaged by fire.

In 1904 most of the business district of Baltimore was destroyed by a four-days' blaze. In 1905 earthquake and fire wiped out part of the residence and nearly the whole of the business section of San Francisco. The earthquake had broken the water mains so there was no adequate means of fighting the fire, and it raged for two or three days, destroying property worth $350,000,000. Sixty thousand buildings were wrecked and 265,000 people were left homeless.

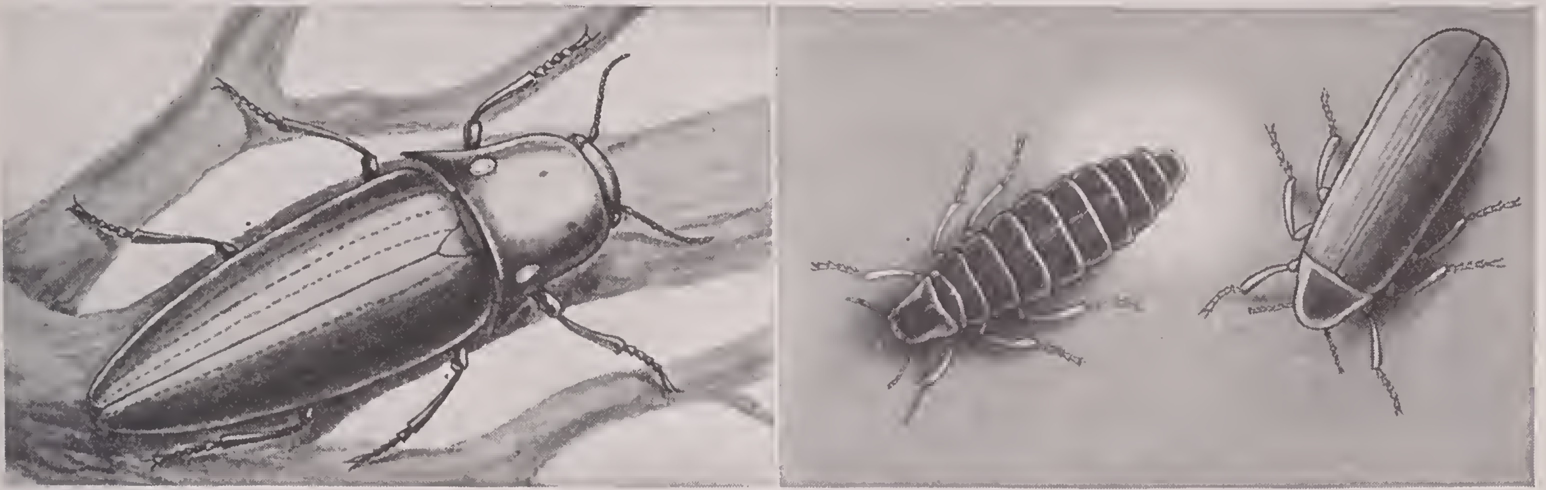
FIRE-EXTINGUISHERS, CHEMICAL. Certain gases, especially carbon dioxide (carbonic acid gas), "smother" a fire just as water quenches it, by preventing it from getting the oxygen which it needs in order to burn. Most chemical fire-extinguishers are contrivances for generating such a gas quickly in time of emergency, and directing it upon the fire.

The hand extinguishers usually consist of a cylindrical metal container partly filled with a solution of bicarbonate of soda. In the upper portion of the cylinder is a glass container filled with sulphuric acid and corked with a loosely fitting stopper. In case of a fire, the cylinder is turned upside down, thus pouring the acid on the carbonate. At once carbon dioxide is formed, which "charges" the liquid just as the same gas charges soda water. When a valve is turned the pressure of this carbonated liquid forces it through the nozzle of the hose. The stream is then turned upon the fire, and smothers it with the fire-choking gas.

Chemical fire-engines are constructed on a similar principle. They are particularly valuable in checking fires in their early stages and in avoiding the damage done by water in the case of the ordinary fire-engines.

FIREFLIES AND GLOWWORMS. The most efficient lighting system in the world is that possessed by the fireflies and glowworms with their "phosphorescent" lights. If you hold your hand near an electric light, a gas light, or an oil lamp, you feel a lot of heat escaping. That heat is wasted energy, an expensive loss. But the firefly has a mysterious way of producing light so that it is virtually all light and no

INSECTS THAT PRODUCE LIGHT WITHOUT HEAT



With all his science, man cannot duplicate the feat of these little beetles that produce so-called "cold light"—that is, light which does not depend upon heat for its origin. The one on the left is the cucujo or firefly of Brazil, while the two insects at the right are European glowworms. The female is wingless and carries the light, which she uses as a signal to her flying mate.

heat. If a man should discover how to imitate this economical plan of the firefly his lighting system would be a hundred times as efficient as at present, and he would not only become rich but famous.

Fireflies—which are not "flies" at all, but members of the beetle order—have been objects of wonder and romantic stories in all ages. Flitting about on warm evenings, or creeping in the damp grass, these "living stars" with their pulsating light produce a weirdly beautiful effect.

Certain large and brilliant fireflies of tropical America, called "cucujos," are captured by the natives and kept in wire cages, where they are fed on sugarcane and bathed twice a day in tepid water. On festival nights they are sold to the young women of the region, who thread them together and weave them in their hair or fasten them to their ball gowns, to glow there like flaming jewels. The ancient Aztecs are said to have confined large numbers of these insects in fine-meshed baskets, which were used as torches on night journeys. In South America there is a remarkable firefly which is said to flash a greenish light on each side of its body and a reddish light at each end. It is called the "railway beetle."

The glowworm, also, which is chiefly a native of Great Britain and northern Europe, is a beetle. The female is wingless and crawls about on the ground at night devouring snails and other small creatures. She alone possesses a lantern, which consists of paired masses of fatty tissue beneath the skin on the under side of the abdomen, and she uses her light to signal to her flying mate. It is of this beetle that the ghost in Hamlet speaks when he says:

> The glowworm shows the matin to be near,
> And 'gins to pale his uneffectual fire.

Naturalists have criticized Shakespeare for these lines, pointing out that he should have used the feminine "her" in referring to the glowworm, and that the light is by no means "uneffectual."

Among the true fireflies or "lightning bugs," as they are often called, both males and females have wings and lanterns. Besides their use as signals to each other, the lights are believed to be useful in warning night birds against gobbling down these insects, for they seem to have a very unpleasant taste and most birds as well as bats leave them alone.

Scientists have puzzled for centuries over the nature of the firefly's light. It seems to be caused by certain mysterious chemicals in the fat tissues, which become luminous when combining with the oxygen drawn in through the breathing tubes at the sides of the body. But all efforts to reproduce an artificial light of similar quality and brilliancy have failed. (*See* Phosphorescence.)

The fireflies found in the United States, as well as the European glowworms, are not more than half an inch long and belong to the family called *Lampyridae*. The "cucujo" of tropical America sometimes reaches two inches in length, and is a relative of the click-beetles, belonging to the *Elateridae* family. Certain luminous centipedes are often mistaken for glowworms.

FIREPROOFING. When we say that a building is "fireproof" we mean that it is built of steel, stone, brick, cement, or some other non-combustible material; or more often that it is only slow burning because of slate or tile roofs and asbestos linings, or is made of wood that has been chemically treated with silicate of soda or borax or phosphate of ammonia. Wood so treated will stand terrific heat, though it will ultimately burn or char.

Cloth also can be rendered fireproof. The same Englishman who made the first coal-tar dye, Sir William H. Perkin, made many experiments in trying to make flannel resistant to flame. He succeeded so well that the heat of a match is scarcely sufficient to ignite a piece of flannel treated by his method. The process consists in dipping the cloth in a solution of different chemicals so that an insoluble compound of tin is formed, or precipitated as a chemist would say, right in the fiber of the goods. Sodium tungstite is also used instead of the tin compound.

The scenery for stages, together with the curtain and other stage properties, are usually rendered as nearly fireproof as possible, because the danger of fire is particularly great in theaters. (*See* Asbestos.)

FLOWERS of FIRE that BLOOM by NIGHT

FIREWORKS. China is believed to have been the birthplace of fireworks. There and in India they attained high perfection. When gunpowder was introduced into Europe, fireworks also came into use. As early as 1540 they were manufactured in Italy, and during the 17th and 18th centuries fêtes were held in which fireworks were used.

But the blaze of fireworks which constitutes such an important part of festivities in Europe and America today was absent a century ago. National holidays were celebrated merely by cannon salutes and bonfires. It was not until the middle of the 19th century that the use of fireworks became general. Today the United States leads the world in pyrotechnics, which is the scientific name for fireworks. Marvelously complicated and beautiful set-pieces are made, such as fiery fountains, portraits, lettered designs, and other elaborate pieces, usually fired by electricity.

FIGHTING OFF PIRATES WITH FIREWORKS

The American brig *Independence*, commanded by Capt. Decimus Forthridge, lay becalmed off the island of Sumatra. It was loaded with a cargo of fireworks, for this was in the year 1840, when China manufactured most of the fireworks of the world.

In the mid-watches of the night came the terrifying cry, "Pirates! Pirates!" All hands swarmed on deck, only to find that no ammunition was available. The murder of the crew and the plundering of the ship seemed inevitable, for two war proas (Malay sailing vessels) were close at hand, filled with dark-skinned cutthroats.

The captain, in desperate desire for action, tore open a box of fireworks and began setting off Roman candles and rockets over the moonlit waters. The pirates stopped, perplexed, and when the leader of one of their vessels was hit by a ball of purple fire, they drew off.

A third proa had crept up unobserved and the pirate crew were stealing up the anchor chains. At this instant the paper wrappings of a box of fireworks blazed up by accident. Captain Forthridge seized it, carried it to the rail, and dropped it into the boat of the attackers. It broke open and the fireworks caught fire. Roman candles spat flame; rockets exploded in every direction; firecrackers popped with terrific noise about the bare legs of the pirates; and pinwheels whirled their fiery sparks about! The Malays went overboard as one man, preferring to take their chances with the sharks. A breeze opportunely came up at this moment, and the Yankee brig sailed jauntily away, leaving the frustrated enemy to nurse their burns as best they might.

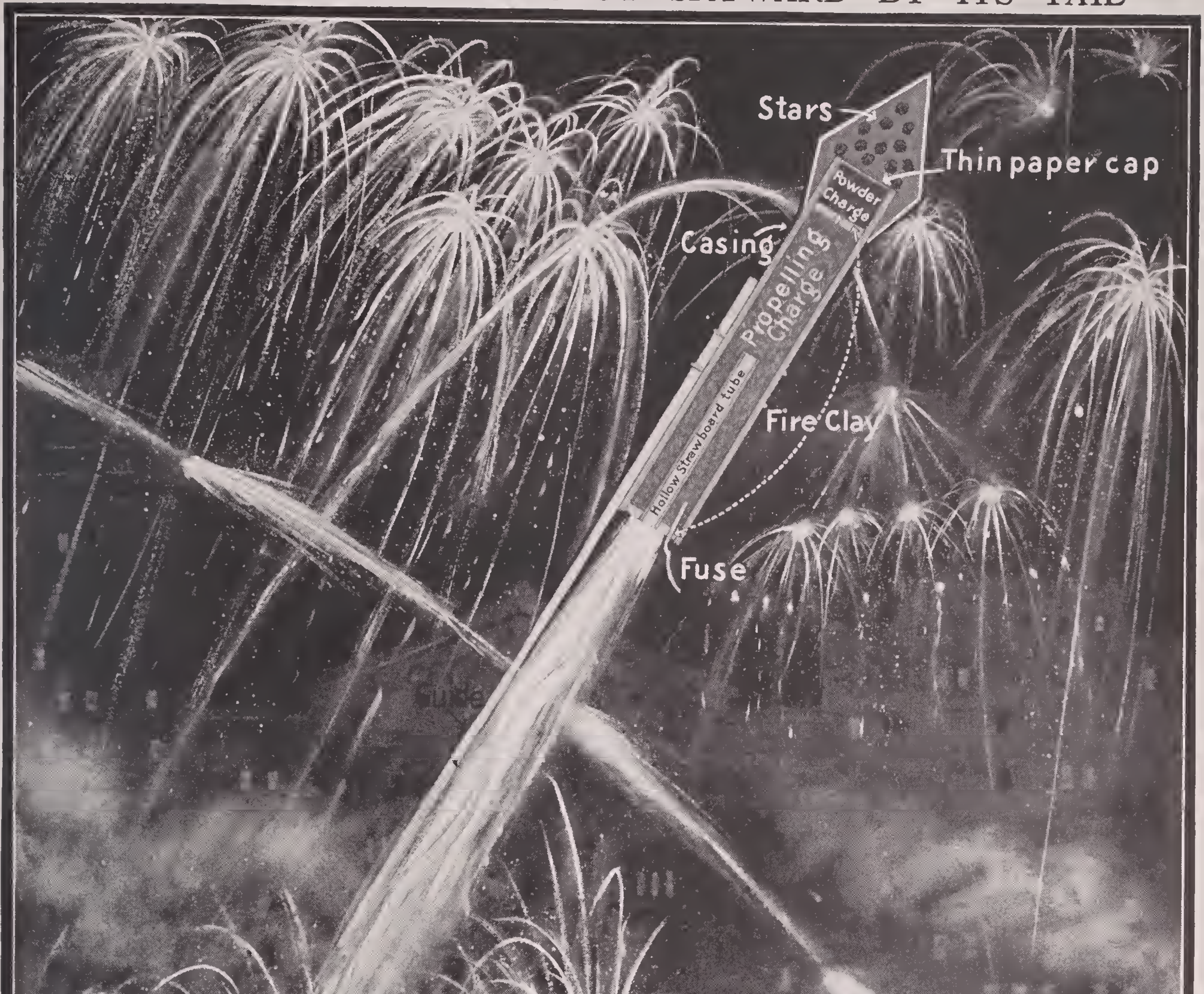
The brilliant colors of fireworks are due to certain bright-burning chemicals such as sodium, which gives a deep yellow color; calcium, which gives red; strontium, crimson; barium, green; and copper, green and blue. Iron filings, which glow brightly under intense heat, are usually used to create the showers of brilliant sparks. In all fireworks there must be the "starting powder," which first catches fire; the "bursting powder," which causes the final explosion, and the "quick match," which leads the spark of fire from one point to another. This quick match is made of cotton wick, which has been saturated in a paste of gunpowder and starch and dried. Resins, soaps, camphor, gums, lampblack, and similar substances modify the character of the discharge.

Fireworks which soar into the air gain their momentum from the sudden discharge of the gases of explosion. We can think of rockets as very light guns loaded very heavily, so that instead of ejecting a bullet or shell, they set themselves in motion by their own recoil.

The stars in Roman candles are hollow balls, made of gunpowder ingredients mixed with light-giving materials, pressed into shape with the aid of gum or shellac, and resting on layers of loose granulated gunpowder. These balls are evenly distributed through the cardboard case, the spaces between being filled with a closely compacted mass of slow burning material. Pinwheels are made by coiling long paper tubes, lightly filled with an explosive composition, about a frame which can revolve freely on its axis.

Rockets consist of a cylindrical case filled with propelling powder, closed at each end with a plaster plug. To the upper end of this case is attached a shorter and wider paper tube containing the chemicals

HOW THE ROCKET IS SHOT SKYWARD BY ITS TAIL

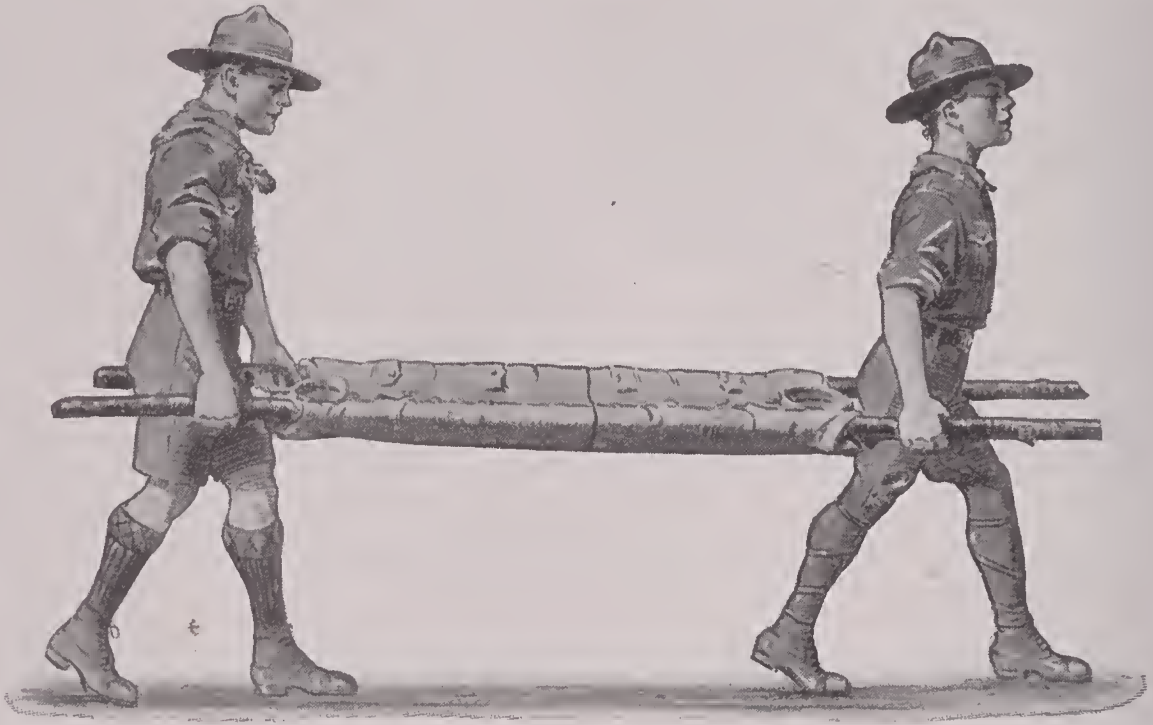


What sends the rocket roaring upward and scatters its beautiful stars across the dark night sky? The answer is easy. The body of the rocket consists of a hollow tube with a strong pointed cap. A plug holding a smaller tube fits into the bottom, confining the powder which forms the propelling charge. When you light the fuse, the flame runs up and ignites this powder, which blows out with great force through the narrow opening. The "kick" of this discharge against the air forces the rocket upward, and it is this backward streaming flame which forms its "tail." Just as the propelling charge becomes exhausted, the fire flashes through the tiny hole at the top, setting off the powder charge which scatters the "stars." The stick on the rocket is to guide it in a straight line.

which create the clusters of stars and the brilliant showers of colored rain. This is set off when the flame from the propelling charge flashes through the hole at the top of the lower case. The stick which is attached to the rocket guides and balances it in its flight. (*See* Explosives.)

Fireworks have their useful side also. For many years rockets, Roman candles, and "Bengal" or colored lights were used as signals between vessels at sea, with an elaborate code by which vessels could "talk" to each other at night. Rockets especially are used as signals of distress. During the World War of 1914–18 great use was made of rockets to signal to the artillery in the rear, telling the gunners when to begin firing and when to cease. "Star shells" fired from cannon were invented as a means of lighting up the "no-man's land" between the lines as a protection against night attack. Exploding in midair, they set free brilliant lights suspended by parachutes which burned for many minutes. The United States Navy further developed star shells as a substitute for searchlights, for they have the advantage of not revealing the position of the vessel, as does the beam of the searchlight.

What TO DO *Till the* DOCTOR COMES



FIRST AID. Two boys were out camping. While chopping wood for a fire the younger one cut his leg badly, and the blood gushed out in spurts. The older boy came running to him, reaching down for a stone and twisting his handkerchief as he came. Quickly he knotted the handkerchief around the leg between the cut and the body, with the stone pressed down tight over the main artery of the leg. Then he cut away the stocking and cleaned the wound as well as possible with a weak solution of iodine, and lightly bandaged it. When they got to a doctor, the older lad was praised highly. By knowing just what to do and doing it quickly and well, he had saved his friend's life. This was a splendid thing to do and it is a thing that every boy and girl should be able to do when necessity arises. The information contained in this article will enable you to act quickly and intelligently in cases of emergency.

Soldiers always carry a "first aid kit" with them, and no one can estimate how many lives have been saved in war by such prompt attention to wounds, either by the victim himself or by his comrades. First aid treatment is not by any means intended to take the place of that given by the doctor. But until he comes it is important that a broken bone should not do further injury to the tissue; that bleeding be stopped as quickly as possible; that an open wound be protected against infection and that the patient be made as comfortable as possible. The Boy Scouts and the Camp Fire Girls each provide a thorough review of first aid treatment in their manuals.

First of all, in case of an accident, it is important that the patient have plenty of air, and yet he must be kept warm. The patient should be moved as gently as possible, and if he is badly hurt it is much better to leave him where he is, provided he is not in a place of danger, until the doctor arrives. Planks or shutters can be used for stretchers, but it is necessary that the bearers should break step in order to prevent jarring. When nothing of this kind is available, a stretcher can be improvised by buttoning up two coats and slipping poles through the arms and along the sides. Such a stretcher, of course, should be thoroughly tested before using it, to make sure that it is strong enough to bear the patient's weight.

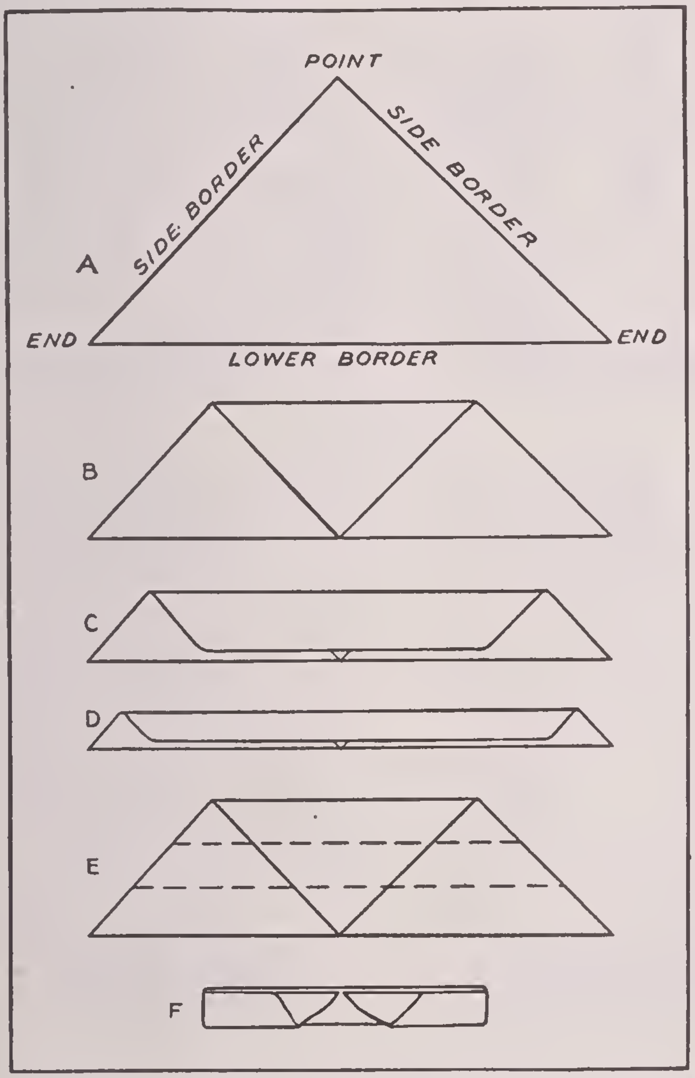
When it is necessary to remove part of the patient's clothing, it must be done with care. In removing a coat, the uninjured side is taken off first. If necessary the stitches in the seam of the other sleeve can be ripped out and the coat lifted away.

Above all, keep in mind the most important rule in first aid work, as given in the Boy Scout's 'Manual': "Keep cool. There is no cause for excitement or hurry. In not one case in a thousand are the few moments necessary to find out what is the matter with an injured man going to result in any harm to him, and of course to treat him intelligently you must first know what is the matter. Common sense will tell the scout there is no time to waste, however, where there is severe bleeding or in case of poisoning."

VARIOUS THINGS THAT YOU SHOULD KNOW

Bandaging. In all forms of injury bandaging is important. It holds dressings in place, supports the parts, and holds the splints in place. When we have no proper bandages we must make use of whatever is at hand. The simplest bandage, and the most useful in first aid work, is the triangular bandage. This is made by taking a square piece of material 36 inches wide, and cutting it diagonally across from corner to corner. Such bandages are used either folded or unfolded. When folded repeatedly on themselves they are known as cravat bandages, and are very useful in holding dressings in place. Folded or unfolded, the triangular bandage may be used on any part of the body. Smaller triangles are used for the hands and feet. Emergency bandages of this type may be made with a large handkerchief folded diagonally.

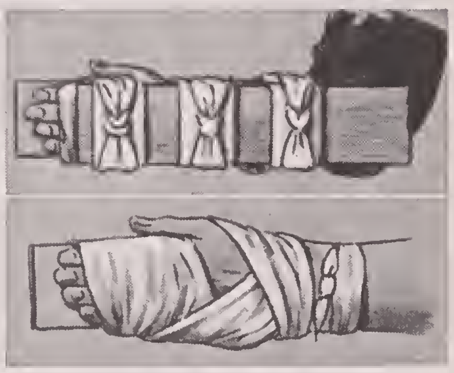
TRIANGULAR BANDAGE AND THE "CRAVAT"



The common triangular bandage is easily made by cutting a square of cloth across the diagonal (A). If the point is folded down (B), and the folding continued (C), the bandage will take the "cravat" form (D). The dotted lines (E) indicate the number of folds. Folding in the ends makes a thicker bandage (F).

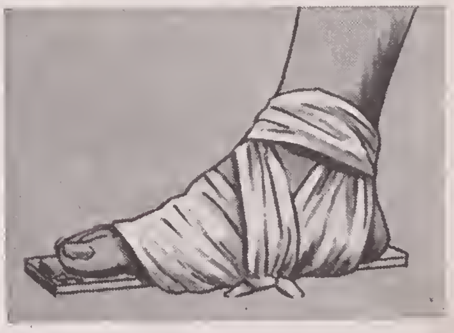
Roller Bandages. Roller bandages are strips of linen or gauze of various widths and lengths. To bind a wound properly with a roller bandage needs more practice and skill than is necessary in using triangular bandages, but they are much better fitting. They are known as circular, spiral, and reverse roller bandages, according to the way they are wound. In a circular bandage each turn covers about two-thirds of the previous one. In spiral bandages each turn ascends a little higher than the previous turn at a slight angle to the parts being covered. During the war we saw many soldiers with spiral puttees wound in this way. The spiral reverse bandage is valuable over a curving swell of a muscle. To wind a bandage in this fashion, after the strip is fastened by one or two circular turns and one spiral turn, the thumb is placed across the last turn and the bandage folded back; the winding is continued, repeating the fold with each turn.

FOR A BROKEN FOREARM



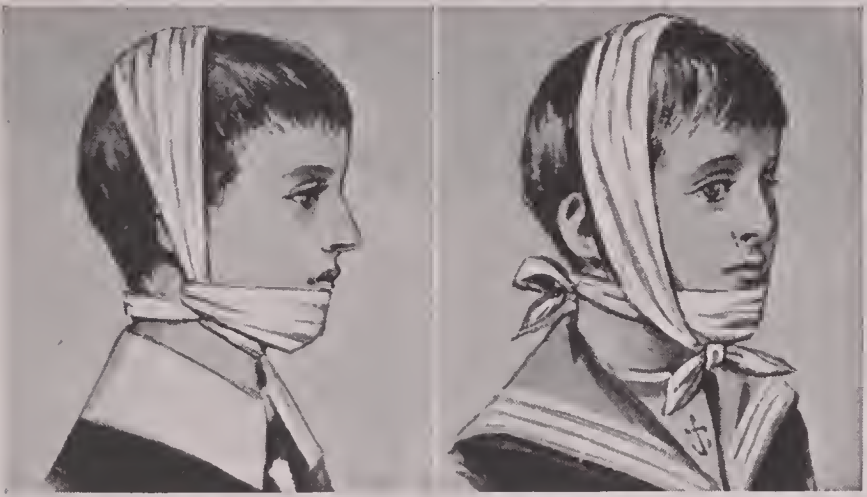
The palm of the hand and the arm can be bound to a board as shown in the lower picture. Another board bound to the back will then hold the entire forearm firm until the broken bones can be set.

FOR A BROKEN FOOT



When toes or other bones of the foot are broken, the injured parts can be held motionless by this simple splint. After cutting away the shoe, a shingle or other small piece of flat wood should be laid against the sole of the foot, and the entire foot strapped to it with a long bandage. The rolling should begin at the toes, work back and be carried around the ankle, and finally be tied beneath the foot.

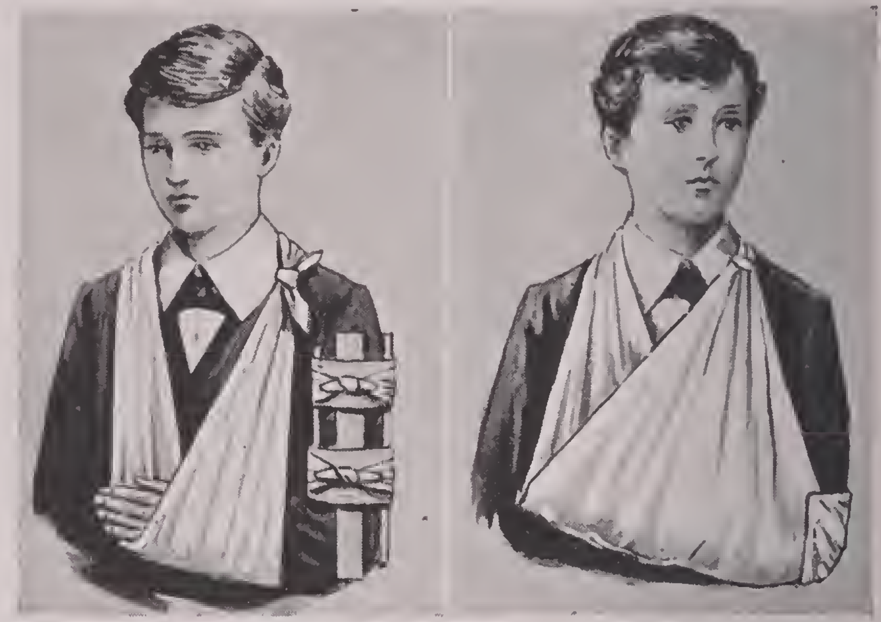
The real art of bandaging consists in applying the bandages properly for the particular injury in question. A bandage must protect the injured part, and usually hold it immobile; at the same time, it must not be in the way more than necessary, and above all, must not slip. This is easily accomplished in cases of injured arms and legs. But for many parts of the body, such as the jaw and the collar-bone, this combination is almost impossible to attain unless one knows the exact method of fastening the bandage in place.



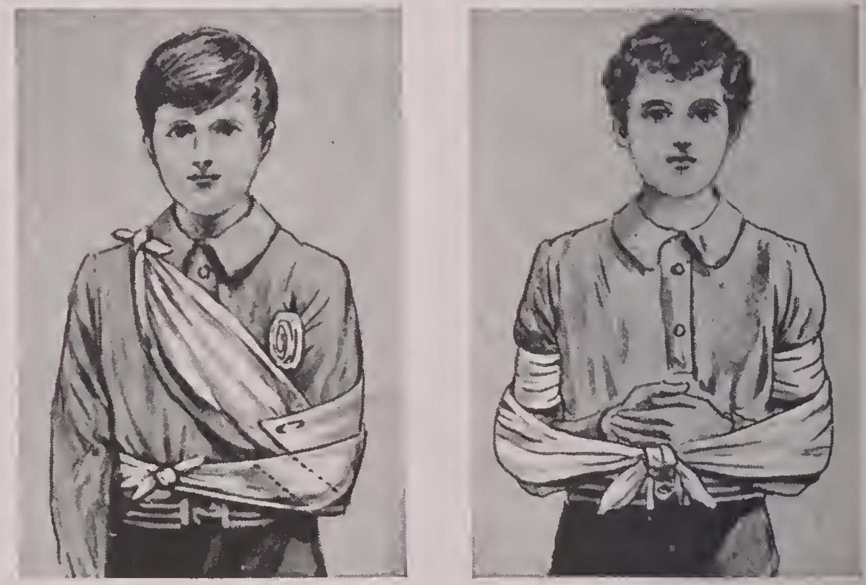
Two ways of bandaging an injured jaw

Bandaging an Injured Jaw. In order to bandage the jaw, it is customary to take a long strip of roller bandage, and cut a short slit in the middle of its length. This portion of the bandage is held with the slit over the chin—by a helper, if possible—and one side of the bandage is carried back to a position near the ear, looped over, and carried under the chin. It is then brought clear over the head, through the loop and around to the rear of the neck, where it may be tied to the other end coming from the jaw. One of the illustrations shows this bandage, with an accompanying picture to show how two rough bandages may be used to obtain much the same result.

Arm Bandages. In almost all serious injuries to the arm a sling of some sort is necessary. If the injury is in the upper arm, any supporting sling will do, so long as it is not too narrow. If the injury is on the lower arm, however, the sling should be wide enough to support the hand, wrist, arm, and elbow, and should be pinned together or have end patches attached to keep it from slipping sidewise.



How to bind up an arm broken above or below the elbow

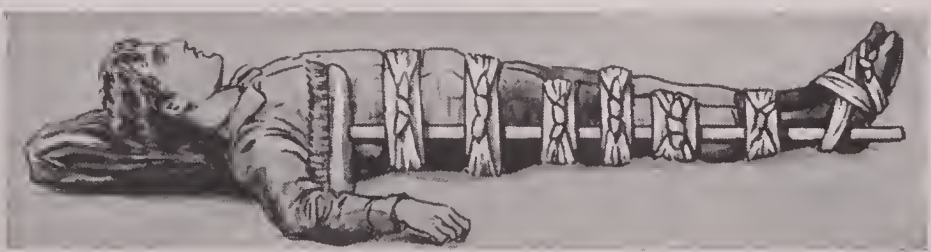


Bandaging for one or two collar-bones

Broken Collar-Bone. When a collar-bone is broken, the whole arm must be firmly fixed in such a position that the parts of the broken bone will rest naturally. A good-sized roll of cloth is placed under the armpit, the upper arm is held close to the side, and the forearm folded diagonally upward across the chest. One bandage may then be passed along the forearm, diagonally upward across the back, and tied over the shoulder nearest the hand. A horizontal bandage is then applied to confine the elbow to the side. As a further precaution you should pin or bind the two bandages together at the elbow.

If both collar-bones are broken, the forearms are folded across the abdomen. A few turns of a long bandage are taken around one arm above the elbow, and one end is carried tightly across the back and circled about the other arm. Each free end is then brought to the front around the elbow and tied together.

Broken Leg. Dealing with a broken leg is easy. Any long stick, or even the other leg, may be used as a splint.



How to hold a broken leg in a safe position

Resuscitation of the Drowned. Of several methods, the Schaefer or prone method is one of the best, as only one operator is needed and the work of producing breathing can begin at once. The patient is laid on the ground, face downward, with the face a little to one side and the arms stretched above the head. It is important to remember that never, even for a moment, must the patient be raised to a sitting posture, as water will then rush to the bottom of his lungs and the resuscitation will be harder to accomplish. The operator kneels astride the prone figure placing his hands in the spaces between the short ribs. By pressing with the entire weight of the upper body, air is forced out of the lungs; then by relaxing the pressure the chest cavity is enlarged, and air rushes in to take the place of that forced out. By pressing and relaxing alternately 12 to 15 times a minute, artificial breathing is accomplished. If the pressure does not bring the water out at once, see that the mouth is clear, taking care to wedge the teeth apart. Sometimes it is necessary to work for an hour before the slightest flicker of an eyelid or a gasp rewards the life-saver's work; and even then the natural breathing must be aided with artificial breathing for a long time. Do not attempt to give the patient any stimulant until you are sure he can swallow, for the fluid will run down into the lungs instead of the stomach.

When there is only one person with the victim, all his time must be taken up in producing artificial respiration, for that is the matter of greatest importance. If there is another person present he should see that the patient's mouth is clear, that the tongue is well forward, and that no tight collar restricts the neck. Sometimes it is necessary for both persons to exert their whole weight in overcoming the stiffness of the abdominal muscles. When these preliminaries have been accomplished, the second person should telephone for a pulmotor, if one is available. This is an apparatus for forcing oxygen and air into the lungs. The after-treatment is important, and consists in putting the patient to bed and keeping him warm and quiet, as there is danger of pneumonia.

An Alphabet of Emergency Hints

The following directions apply to first aid treatment for mishaps of common occurrence:

Bites of dogs, cats, snakes. If on arm or leg, tie cloth tightly around between wound and body. Squeeze wound to make it bleed so as to get poison out. Apply iodine. If hydrophobia is suspected, lose no time in getting patient to the doctor.

Blisters. Never open; apply hot water.

Broken bones or fractures. There are two kinds of fractures, simple and compound. When the bone pierces the skin it is called a compound fracture; when it does not, it is a simple fracture. Send for a doctor at once, as unskilled handling may cause a great deal of harm. If a compound fracture, apply solution of iodine and bandage a sterile gauze compress lightly over the wound. If it is not possible to get the doctor at once, and it is necessary to move the patient, use extreme care and gentleness; tie the limb to padded splints that extend past the joints at either end of the broken bone, tying the bandages outside the splint.

CONTENTS OF THE AMERICAN RED CROSS FIRST AID POCKET EMERGENCY KIT

2 finger dressings
2 small dressings
1 large compress and bandage dressing
2 small bottles of iodine
2 small bottles aromatic ammonia
1 tube carbolated vaseline
1 spool adhesive plaster
4 safety pins

CONTENTS OF A LARGER FIRST AID BOX, PREPARED BY THE RED CROSS FOR USE IN THE HOME AND SUMMER CAMPS

1 2-oz. bottle alcohol
1 2-oz. bottle aromatic spirits of ammonia
1 2-oz. bottle syrup of ipecac
1 2-oz. bottle Jamaica ginger
1 2-oz. bottle liniment
1 2-oz. bottle olive oil
1 2-oz. bottle oil of cloves
1 bottle soda mint tablets
1 bottle cascara sagrada tablets
1 2-oz. bottle iodine
1 package finger dressings
1 clinical thermometer
1 2-oz. package absorbent cotton
1 package small dressings
2 extra long gauze bandages with compress sewed in center
2 triangular bandages
6 assorted bandages
1 1-yard package picric acid gauze
1 spool adhesive plaster
1 pair scissors
1 paper safety pins
6 wooden tongue depressors
1 package paper cups
1 tourniquet

Bruises. Apply very cold water at first, or witch hazel, or arnica, or vinegar diluted with water; afterwards use hot applications. If the skin is scratched, wash with warm water and pure soap and apply iodine.

Burns and scalds. A burn is caused by dry heat, a scald by moist heat, usually steam or boiling water. To relieve the pain some dressing to exclude the air is needed. Pastes made of water and baking soda, carbolized vaseline, olive or castor oil, and even fresh lard and cream are good. Carron oil, a mixture of linseed oil and limewater in equal parts, is soothing. If clothing adheres to a burn, never tear it away, but cut it carefully as close to the wound as possible. In case of very severe burns, when the skin and tissues are charred and destroyed, little can be done. Send for a doctor at once, and make the patient as comfortable as possible.

Chills. Put hot water bottles under arms, on thighs, and at feet. Rub limbs toward body, to restore circulation. Chills may be the first indication of serious illness, so a doctor should be sent for.

Choking. Slap the patient on back. If the choking persists, cause vomiting by passing finger down throat, or by giving a small dose of ipecac. If the patient is a child, hold it up by the feet, head downward, and slap on the back between shoulders.

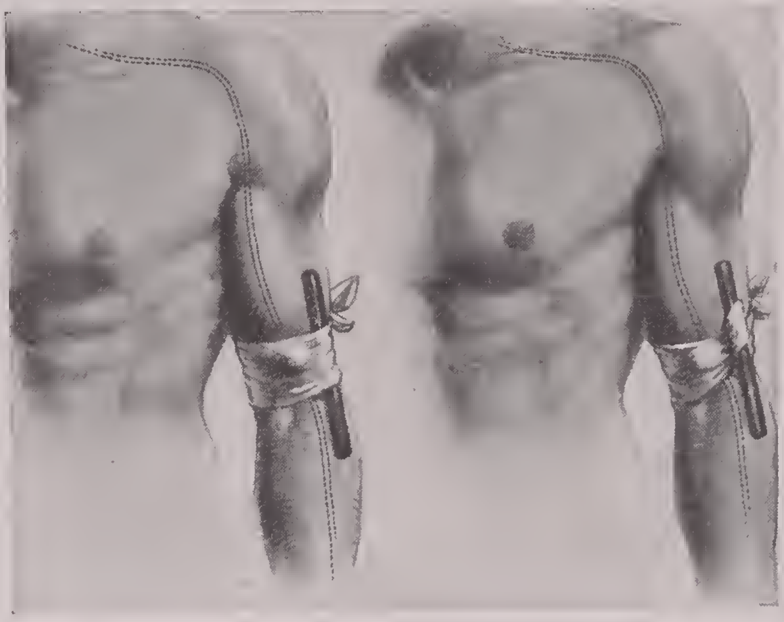
Cold. At the first sign of taking a cold, use some simple remedy such as aspirin to dispel it. If it becomes severe, see a doctor. Neglected colds are dangerous.

Convulsions. Put patient in warm bath with cold cloths at head.

Croup. This is usually more alarming than dangerous. Give the patient one teaspoon of ipecac to cause vomiting. Keep in warm room with plenty of moisture in atmosphere until entirely recovered. If croup is not cleared up in 24 hours, call a doctor.

Cuts. The first thing to be done is to stop the bleeding. In simple cuts this may be done by the application of cold water or by moderate pressure on the wound. When a large vein or artery has been severed, any delay is dangerous. Lay the patient down with the head raised only slightly, but with the wounded portion raised as high as possible. Lay a pad or compress over the cut, first bringing the edges of the wound together, and fasten with a bandage and wet with cold water. If the wound is in the leg or arm, and the compress fails to staunch the blood, pressure must be applied to the artery or vein. This is done with a tourniquet. In the leg the artery is in front and a little below the groin. In the arm it is on the under side, under the biceps muscle. Place over the artery a small piece of wood, a little stone, or a hard knot tied in a handkerchief; and over this and around the limb tie a bandage made of anything at hand. Run a stick between the cloth and the flesh and turn it until the pressure on the artery is sufficient to cut off the circulation. Cutting off the circulation for very long at a time is dangerous, and the bandage should be loosened as soon as possible; in no event should it be left on for more than an hour. Be ready to tighten it again, however, if bleeding begins anew. If a vein has been severed, the tourniquet must be applied between the wound and the end of the limb. Pressure directly over the wound is the only way to check the bleeding when the cut is in the body. For slight cuts touch with tincture of iodine.

THE GREATEST LIFE SAVER OF ALL



Broken bones can be let alone if necessary—but bleeding arteries must be stopped or the victim dies. Therefore the tourniquet, as shown above, for stopping the flow of blood, is the one first-aid device that everyone should know. It is applied by laying a pebble or a knotted cloth over the artery (shown by the dotted lines) somewhere between the cut and the heart, fastening a bandage over the spot, and then by twisting a stick thrust through the bandage, tightening it so as to press the stone or knot upon the artery and stop the flow of blood.

Earache. Apply a cloth which has been wrung out of hot water in which there are several drops of alcohol.

Electric shock. Very often the victim of electric shock is still in contact with the current that has stunned him. In such cases the first thing to do is to remove him from contact with the wire. The rescuer should protect himself by standing upon a dry spot, using a dry stick to move either the patient or the wire, or otherwise insuring that he himself be not disabled. After this has been done, artificial respiration should be started. Electric burns should be treated like all other burns.

Fainting. Keep crowd back. Place the patient in a horizontal position and dash cold water in face. Let patient inhale ammonia or smelling salts. Remember that an unconscious person cannot swallow.

Foreign body in the ear. If it is an insect, drown out with warm olive oil. A light near the ear often attracts the insect out.

Foreign body in eye. Wink; never rub. Pull upper lid over lower, blow opposite nostril. Wrap the end of a toothpick with absorbent cotton, dip in solution of boracic acid, and wipe gently across the eyeball. If the foreign body can be seen touch the swab to it lightly and usually it will come away with the swab. Be careful not to press upon it, however, for this may drive it into the eyeball.

Frost bites. Rub with snow or cold cloths. Do not bring patient into warm room.

Heat exhaustion or sunstroke. Reduce high temperature of body either by wrapping the patient in a sheet which is kept saturated in cold water, or by applying ice-water cloths to the head, back of neck, and hands. Send for the doctor. Simple heat exhaustion calls for rest and quiet in a cool room.

Hives. To stop the itching rub with common salt, or bathe with equal parts vinegar and water. Hives indicate stomach trouble.

Nausea (sickness at stomach). Swallow small pieces of cracked ice, soda mint, or lime water (clear solution of slaked lime).

Nosebleed. Keep head upright; raise arm on bleeding side; apply cold cloths to back of neck and across bridge of nose. If bleeding continues, plug the nostril with cotton saturated in hydrogen peroxide.

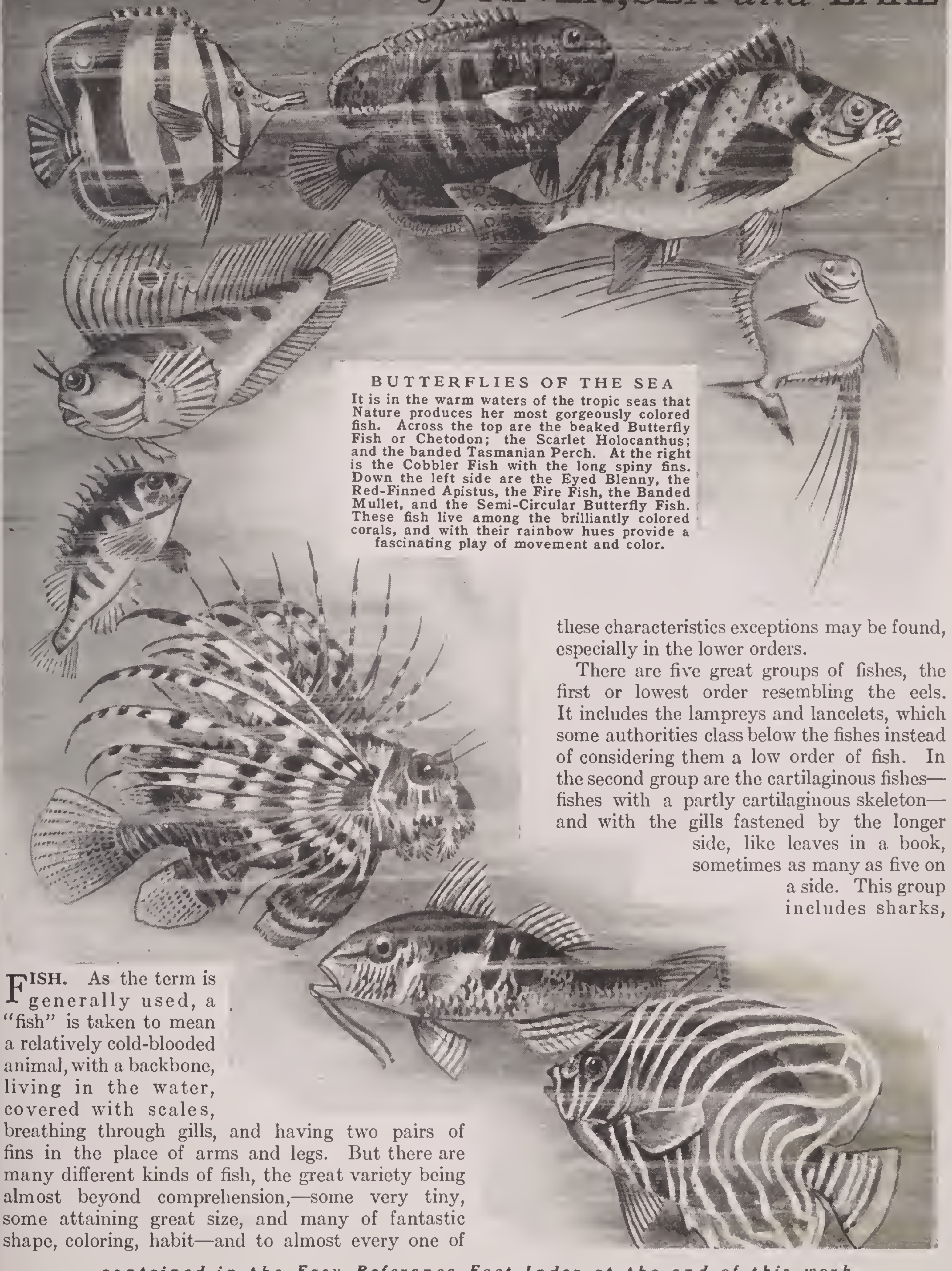
Poisoning. There are three kinds of poisons—those that affect the nervous system, such as opium, aconite, alcohol; those that irritate the digestive tract, such as arsenic, tainted food, etc.; that those corrode or burn, such as carbolic acid, lye, bichloride of mercury, etc. An emetic is given in all cases of poisoning except when lye or other caustic alkalies have been swallowed. Then an acid (vinegar and water, lemon or orange juice or other dilute acid) is first given to neutralize the effect of the alkali, and this is followed with whites of eggs in milk, and olive oil. In poisoning by all acids except carbolic, give alkalies—baking soda (1 teaspoonful in a cup of water), lime water, magnesia, even a tablespoon of strong soapsuds if nothing else is at hand. Follow with the beaten white of an egg and milk, olive oil, and coffee. For carbolic acid poisoning, give alcohol and water; if alcohol is not at hand, give a tablespoon of epsom salts in a glass of water, or beaten whites of eggs in milk. For laudanum or opium poisoning, give an emetic followed by strong black coffee, and (most important of all) keep patient awake by walking, slapping, or any other means. If the patient falls asleep it is liable to prove fatal.

Ptomaine poisoning. Vomiting is necessary, so give warm mustard water or ipecac; give castor oil. If the attack is severe, see the doctor.

Sore throat. Wrap throat with cloth wet in alcohol. Gargle with salt and water. If persistent, see doctor.

Splinters. Open the wound with a sterile needle, and pull out splinter from direction it entered. Apply iodine over the spot.

FINNY DWELLERS of RIVER, SEA and LAKE



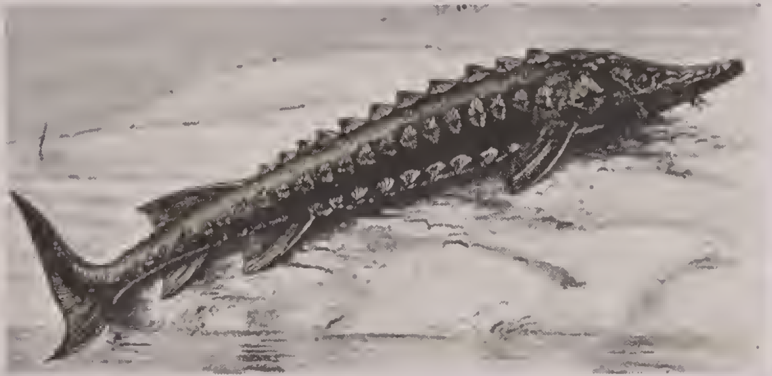
BUTTERFLIES OF THE SEA

It is in the warm waters of the tropic seas that Nature produces her most gorgeously colored fish. Across the top are the beaked Butterfly Fish or Chetodon; the Scarlet Holocanthus; and the banded Tasmanian Perch. At the right is the Cobbler Fish with the long spiny fins. Down the left side are the Eyed Blenny, the Red-Finned Apistus, the Fire Fish, the Banded Mullet, and the Semi-Circular Butterfly Fish. These fish live among the brilliantly colored corals, and with their rainbow hues provide a fascinating play of movement and color.

FISH. As the term is generally used, a "fish" is taken to mean a relatively cold-blooded animal, with a backbone, living in the water, covered with scales, breathing through gills, and having two pairs of fins in the place of arms and legs. But there are many different kinds of fish, the great variety being almost beyond comprehension,—some very tiny, some attaining great size, and many of fantastic shape, coloring, habit—and to almost every one of these characteristics exceptions may be found, especially in the lower orders.

There are five great groups of fishes, the first or lowest order resembling the eels. It includes the lampreys and lancelets, which some authorities class below the fishes instead of considering them a low order of fish. In the second group are the cartilaginous fishes—fishes with a partly cartilaginous skeleton—and with the gills fastened by the longer side, like leaves in a book, sometimes as many as five on a side. This group includes sharks, rays, and skates. The outstanding characteristics of this group are the skeleton, consisting of gristle without bone, and the peculiar skin. They have no true overlapping scales; the skin is tough and mottled, and is naked, or covered either with wart-like projections, tipped with a hard bony pimple called *shagreen*, or bony scales resembling teeth. The third group, the bony or modern fishes, includes most of the food and game fishes in fresh and salt water—the cod, bass, perch, trout, pike, mackerel, etc. The fourth group is composed of the armored fishes or *ganoids*, covered with enamel-like scales and sometimes further protected with spines and prickles. Under this group are the gar-pike, the needlefish, the sturgeon, the bowfin, and the alligator gar. Fossil fishes of this group are found in very ancient rocks. The fifth group consists of the mud-fishes or double-breathers, possessing both gills and lungs, which enable them to live in the air under certain conditions. They have some very peculiar fins, that are more like legs than those of other fishes.

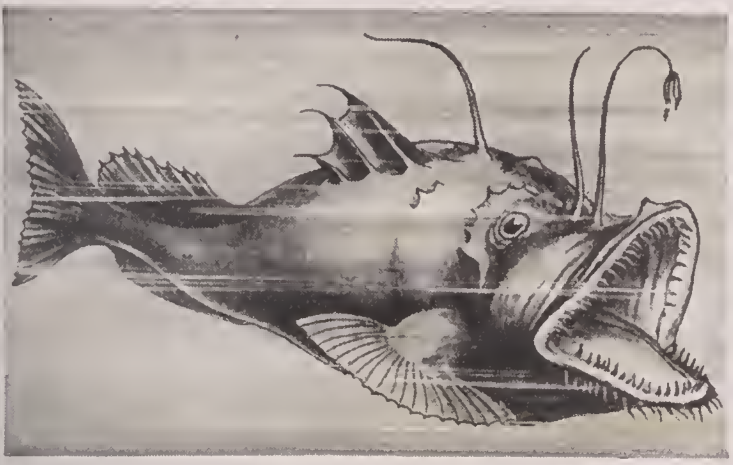
HIGH AND LOW IN FISH SOCIETY



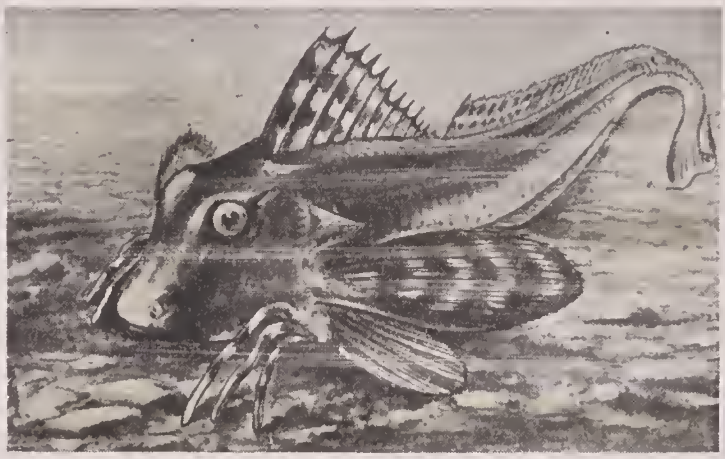
The Lamprey in the upper left-hand corner is perhaps the lowest member of the society of fish. The trouble is he hasn't any real backbone. It's just cartilage, and some scientists refuse to consider him a true fish at all. On the other hand the Trout, to the right, belongs to the very highest family of "Bony Fishes." That sharp-nosed Sturgeon, next at the left, is a member of the very ancient Ganoid stock, which was prominent in the Paleozoic Age, but has now fallen to a low estate. The Lung-Fish, next to him, is a sort of outcast, for he breathes with lungs and can live a long time out of water, things no proper fish would think of doing. The Sting Ray, at the bottom, is a villain who not only breaks the rules of good fish form, but carries a poisoned dart on his tail.

The body of a fish is shaped like a boat—or perhaps it would be better to say that man, seeing how easily the fish cleaves the water, patterned his boat from the shape of the fish. The head is fastened without a neck, and the greatest width of the fish's body is in front of the middle. A flattened tail is used to propel the fish through the water, the fins directing the course. Most fish depend on speed to secure their food or to escape from their enemies, so their bodies are shaped for speed; but there are some fish that hide on the bottom of the sea, or in crevices, and others, as mentioned above,—that are protected by bony plates. Some of these fish are almost globular in shape. The body is generally covered with overlapping scales, growing attached to the skin. Some are covered with smooth skin, as the cat-fishes, and the *ganoids*, as stated above, are armored.

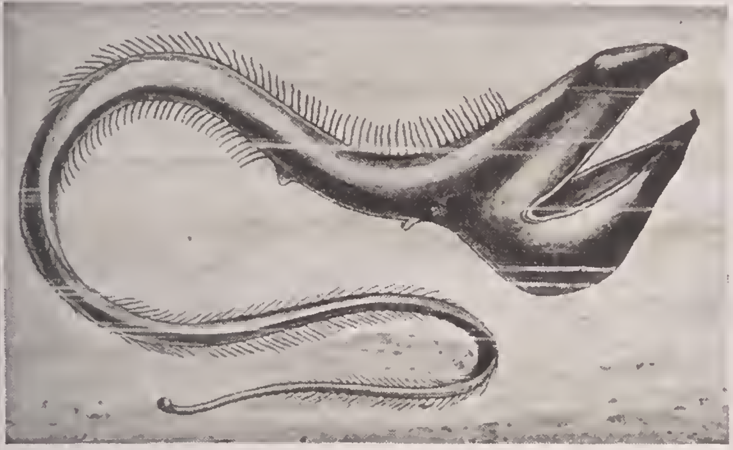
A FEW OF NATURE'S FISHY FREAKS



The Frog Fish, or Angler Fish, lies on the ocean bottom with his mouth open. His waving feelers attract small fish, and when one comes close enough, the great jaws fly shut and the Angler dines.



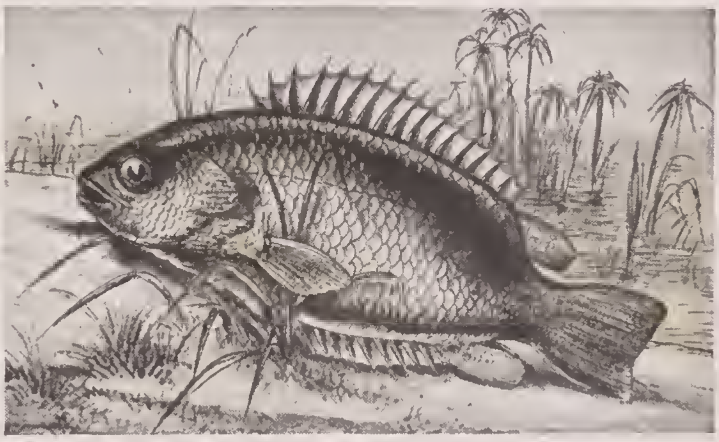
The curious Streaked Gurnard has a huge armored head and organs like fingers with which he walks on the sea bottom. His side fins are also unusually large. His family consists of many varieties throughout the ocean.



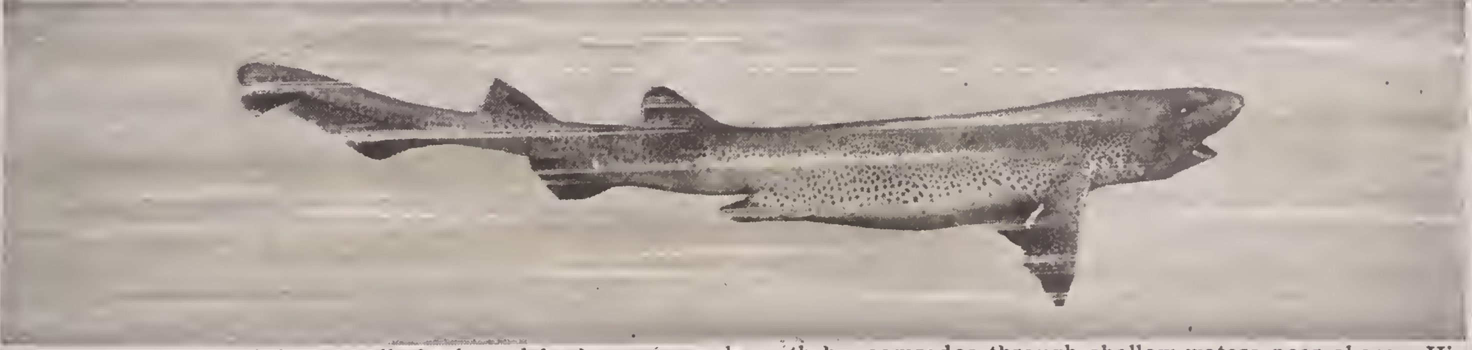
This deep-sea monster, who seems all mouth, belongs to the "Pelican Fish" family and lives in the black and icy depths, where the sun's rays never penetrate.

The Electric Eel is Nature's greatest storage battery. His "charge" is strong enough to shock a horse, and comes from electric cells along his sides.

The Flying Fish is one of Nature's puzzles. Scientists cannot agree whether he really flies by flapping his fins, or merely soars through the air. Whichever may be the truth, some varieties of flying fish can cover 200 yards or more in the air, and even alight on the decks of ships in efforts to escape their enemies.



The Climbing Perch of India saunters about on land in search of new water when his old home threatens to dry up, and sometimes even climbs trees. He does this usually during the night or early morning when dew is on the ground. He has a special arrangement for keeping his gills wet during his land travels.



The Spotted Dog-Fish is a small shark, and he hunts in packs with his comrades through shallow waters near shore. His long body with his powerful fins makes him a highly efficient hunter, and fishermen dislike him because he scares away the food fishes.

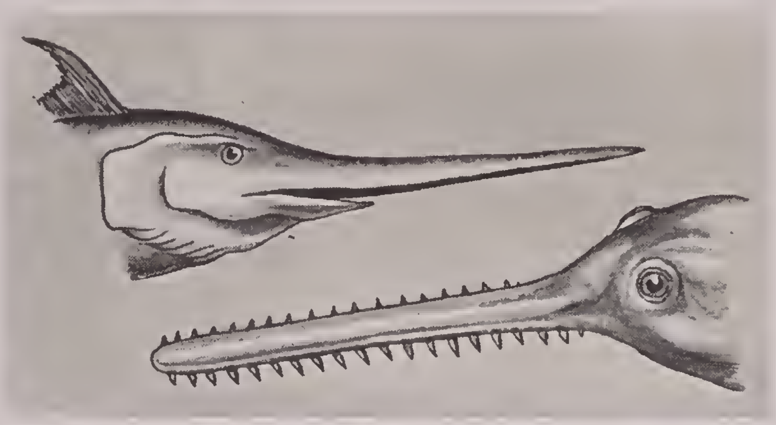
The movement of the tail and fins is controlled by muscles and it is this part that we eat. The backbone is loosely jointed, so that the fish may turn, twist, and dart at ease. Most fishes possess an air-bladder, but its purpose is not clear; it has been regarded as a balance, weighting or lightening the body as required. In the lung-fishes the air bladder is divided to form the lungs.

How a Fish Gets His Breath

A heart pumps the red blood through the body, just as it does in the higher animals. The blood is purified in the gills by the oxygen in the water. Sometimes when the water is foul, the fishes come to the top and try to gulp in the air, but their gills are not fitted to use the oxygen in the air. Fishes breathe the water by taking it in at the mouth, letting it flow over the gills and out through the opening behind the gill covers.

Along the sides of fishes there is a line called the lateral line which is made up of peculiar scales, beneath which there are a great number of nerves. This is probably a sense organ helping the fish to perceive disturbances in the water.

TWO TERRORS OF THE DEEP



The Swordfish is a murderous creature, who fights without reason. He will attack anything from a whale to a small boat, and has even been known to pierce the sides of large ships with his sharp nose, which grows as long as three feet. The Sawfish, however, is more cruel than bold. He takes delight in chopping up such soft-bodied animals as the octopus and the cuttlefish with his jagged six-foot snout.

A fish has a face something like that of the higher animals. There are eyes, a nose, and a mouth. The eyes of fishes vary greatly in size and form. There are no eyelids and the fish can see but a little distance. In the Mammoth Cave in Kentucky, and in other caves, the fishes are blind; once they had eyes, but through long disuse the eyes have lost their sight. Deep-sea fishes have very small eyes. The power of smell is located in the nostril, but it is very feeble. This nostril is a closed sac and has nothing to do with breathing. There is hardly any sense of taste. The tongue is hard and gristly and immovable, and the fish eats very fast, chewing merely to cut or crush the food, often swallowing it whole. Fish hear scarcely at all, and the hearing apparatus is buried in the skull and has nothing to do with the earlike flaps. They are, however, very sensitive to disturbances in the water, as the sense of touch is very highly developed. If they come in contact with a moving object fish dart quickly away. Some fish have sensitive feelers or "barbels" by which they explore the bottom or feel their way to food, and these barbels are highly specialized. They are attached sometimes to the nostrils, sometimes to the jaw-bone, sometimes to the skin of the chin or snout, and sometimes over the eyes. The goat-fishes of the tropics are named for the two long barbels that hang from their chin.

The nervous system of the fish is not highly developed, and it feels very little pain. It often happens that a fish which has torn itself loose from the hook will be caught again soon after, still bleeding from the first wound.

The mouths of the various genera and species differ widely. Sometimes the mouth is a great horizontal gash almost from gill to gill, sometimes it is round and tiny, and sometimes it is developed into a long snipelike beak. The jaws also differ widely. Sometimes the bones are joined with ligaments that may be stretched, especially among deep-sea fishes, so that the fish may swallow other fish larger than itself. Sometimes the jaws are tubelike, and it is a wonder that the fish can swallow anything. The mouth may have no teeth, or the teeth may be on the jawbone only, or on any bone in the mouth's circumference. Just inside the mouth are gill rakers which strain the water, and at the opening of the gullet behind the gills are bones armed with additional short thick teeth.

There are almost as many colors of fish as there are shapes. The ground color is usually protective, with mottled or barred colorings. In the majority of cases the ground color of the back is gray or a sort of olive, with the belly white. To birds looking down on the water the back with its mottled stripes is the color of the water with the shadows on it; to fishes below in search of prey the belly is the color of the surface of the water, with the atmosphere above it. In the tropics where red seaweeds and other aquatic growths of brilliant colorings abound, the fish are bright colored. In the greater depths of the ocean, the fish are deep black or violet black, sometimes with silvery phosphorescent lights.

"Camouflage" in the World of Fish

A writer in the Bureau of Fisheries has the following to say regarding the color changes of fish:

"Camouflage is a new word to the English language and a new art developed under the stress of necessity, but it is old in nature, especially among many of the lower animals. Hiding-colors to resemble a background or the general color tone are exhibited by most fishes and in many cases the likeness is very close, as may be observed by a visit to any aquarium, especially in regard to the flounder. In these fishes the skin changes to resemble the varying patterns not only in color but even in the pattern in which the color is arranged and it is often difficult to see them as they lie exposed in the tanks. These changes result automatically from impressions received through the eye and if the head lies over a back-

HE'S NOT HANDSOME, BUT HE'S A FAITHFUL FATHER

Unlike most fish, who abandon their eggs and young to fate, this exceedingly plain male Lumpsucker stands guard over the eggs, and defends them with great courage against prowling enemies. He gets the last half of his name from the "sucker disc" he carries between his lower fins, which he uses in attaching himself to various objects.

ground of one color and the rest of the fish over another, the entire body adapts itself to the color and the pattern nearest the eyes.

"But there are color changes which apparently have little or no relation to camouflage. We are all familiar with the changes of the human face under stress of emotions, the flush of anger, the blush of shame or embarrassment, and the pallor of fear; but it is not generally known that in fishes there is a much more vivid and extraordinary play of color correlated with varying moods and emotions. There are color patterns characteristic of fear or alarm, of anger or belligerency, of rest and play, and in some fishes these phases differ from one another so markedly that the uninitiated would be warranted in believing them to characterize distinct species and not mere 'states of mind' of the individual."

Little interest is displayed by most fishes in their young. After the eggs, a jelly-like mass, are deposited, they are left to hatch or be destroyed as chance wills. There are exceptions to this practice. The stickleback builds carefully a nest of sticks cemented with an excretion from his body, and after the eggs are deposited stands guard until the fish are hatched. Bass and sunfish also guard their eggs. The male frog-fish is said to pick up the eggs deposited by the female, and blow them from his mouth along with bubbles of mucus, which hardens about the mass of eggs and forms a light floating bag. Some species of fish, among them the salmon and shad, leave the sea and ascend to the headwaters of rivers to deposit their eggs; others, such as the common eel, living in fresh water, go to the sea to spawn. Some fish hatch their young in an egg-sac attached to the body. Some of these baby fish are tiny at birth, some quite large. Some sharks and a few other fishes are born alive. Most young fish take care of themselves from the first. The destruction of eggs and young is very great, for almost every species is a prey of larger fish, so the vast numbers of eggs that are deposited by some fishes are necessary to preserve the existence of the species. For example, a large cod produces about 10,000,000 eggs every year.

Violent Death the Rule in the Fish World

In general the young fish differ from the adult only in size and proportion. The eyes and head are comparatively larger, the fins are lower, and the body comparatively more slender. Most fish live on indefinitely, or until they fall victims to larger species. The exceptions to this rule are those fishes, such as the salmon, which have a definite period of growth before spawning, and after spawning die.

Some fish are killed more readily than others. Fish usually die very quickly in the air or in foul water. Wisconsin farmers, however, after high water has covered their land, often plow up still living

HE ROUNDS UP VICTIMS WITH HIS TAIL

The Fox or Thresher Shark beats the water in the vicinity of herring or mackerel schools with his tail. This frightens the smaller fish and they flock together. When the mass is dense enough to suit the shark, he rushes in with his mouth wide open, and scoops in a satisfying meal.

mud-minnows buried in the mud. The Alaska blackfish, a similar fish, has been fed frozen to dogs and has been recovered alive after being thawed out by the heat of the dogs' stomachs. A cat-fish may still be alive hours after it has been thrown on the bank. The African lung-fish lives in a ball of half-dried mud during the dry season, and some of the Asiatic lung-fishes can maintain themselves for a long time out of water. Carp frozen in the ice are said to revive in the spring.

Some fish eat both vegetable and animal matter, others eat only vegetable matter, and still others confine their diet to other fish. In flesh-eating fish the mouth is large. Some fishes live on minute organisms strained from the water.

Altogether there are about 13,000 species of fish, all interesting, and many with remarkable characteristics and fantastic shapes and colorings. The tunny, a giant mackerel of the Mediterranean, grows nearly 20 feet long and weighs 1,000 pounds or more. The man-eating shark, found occasionally in all warm seas, reaches a length of 30 feet and sometimes weighs 500 pounds; it is swift, enormously strong, and the most voracious of fishlike animals. The "Port Jackson shark" is the largest of fish, and attains in rare cases a length of 50 feet. The oar-fish, on the other hand, although it attains a great size, 600 pounds or more, is stupid and defenseless and has a body half-transparent. Some writers think that this is the famous "sea serpent with a horse's head and a red mane" that at times has caused so much excitement on the southern seacoasts of the country. It is a deep-sea fish, light bluish in color, with a slender and sinuous form, compressed like a ribbon, and with its dorsal fin tipped with red. The head has a long jaw and a high forehead,somewhat resembling a horse. When driven from the depths of the sea, its body swells and bursts because of the decreased pressure of the water, and it is thus sometimes washed ashore.

As to the Voices of Fish

Fish usually have no voices, but there are fishes which do make a distinct noise. Sometimes this is a grating sound caused probably by the rubbing together of the short thick teeth of the gullet; and sometimes it is a quivering or singing sound, probably arising in the air-bladder. The singing fish of the California coasts is an example of the latter.

Some fishes have curious weapons of offense and defense. There are the electric fishes, with power to inflict electric shocks on their prey or their enemies. The electric eel, which is not an eel but more like the carp, inhabits the rivers of Brazil and the other countries of South America and its shock is powerful enough to stun a man. Some fishes are provided with a poisonous slime or mucus which flows over the spines, so that a wound made by them is very painful. The spines of the common cat-fish have this property to some extent. In some fishes the form of this spine is modified so as to form a poisoning instrument, and the poison is pressed through the tube as the spine is thrust in. The greater weever of the African coast has poisonous spines on its gill covers.

The frog-fish of the tropical seas have two fins resembling legs, with which they creep along the rocks like toads. The head is the largest part of the body and the mouth the largest part of the head.

HOW THE "FISH DOCTOR" WORKS

Although the fish doesn't consult the doctor, in fish culture stations the doctors treat him anyway whenever necessary. Here we see a "fish doctor" removing a fungus growth from the fish's gills.

The jaw muscles are strong and the teeth sharp. This fish belongs to the anglers—fishes with barbels hanging down in front of their mouths, presumably to attract other fish within reach. Some of these barbels are bright colored, some glow with a phosphorescent light.

In the swordfish and sawfish the snout is prolonged into a flat blade with a series of strong teeth implanted along its sides. Besides this they have remarkable jaws for catching food and strong true teeth.

Here the doctor is puncturing the air-bladder, because some internal disorder has caused it to be unduly inflated.

In East India there is the climbing perch. When there has been a heavy rainfall and the water runs profusely down the trunks of the trees at the edge of a pool, these perch crawl up the tree sideways, sometimes to a height of five to seven feet. If the fish is thrown on the ground it runs rapidly along in the same sidewise manner, as long as the mucus remains on its skin. The flying-fish are capable of lifting themselves from the water and soaring through the air, sometimes for a quarter of a mile, the large pectoral fins spreading as a parachute to sustain the body.

The fishes of the tropics are often brilliantly colored. The parrot fishes of the Mediterranean coast and the Indian Ocean have vivid colorings of red, green, and purple; and the butterfly-fishes are striking examples of black and yellow coloration. The goldfish of China and Japan are found only in domesticated specimens, the brilliant coloring being retained by artificial selection. The original goldfish was olive colored, as is shown by descendants of specimens which have escaped into the Potomac River.

The value of fish to men is not confined to its use as a food. Many fish are sought for the oil which they yield, while the skin of some others is valuable. From dried and powdered fish offal valuable fertilizers are manufactured.

How Fish Came to be Fish

Fish are particularly interesting from the point of view of the theory of evolution because they are regarded as the first vertebrate (backboned) creatures produced by nature. Scientists tell us that at a very remote period certain animals began to develop a spinal cord. At first this was little more than a bundle of nerve fibers down their backs. But in the course of time this cord in some of the water dwellers became covered with a jointed rubbery sheath of cartilage to protect it, and riblike arches grew out from this sheath. At the same time the skins of these creatures developed horny dots. These were the ancestors of the fish. Sharks and rays are survivors of this primitive type.

In another group the bony dots developed into armor-like plates, and this "ganoid" type also survives in fishes like the sturgeon. These two families ruled the sea as late as the Coal Age.

Meanwhile another branch developed air-breathing apparatus, and crawled out occasionally upon land, as in the case of the present-day climbing perch. From such creatures developed amphibians, reptiles, and birds. (*See* Birds; Evolution; Reptiles.)

Under water the course of evolution developed the cartilage skeleton into bone and changed the bone-like dots into scales, thus creating the highest type of fish, such as the trout. The development continued until the period which geologists call the Pliocene, since which time the fish family has undergone practically no change.

This picture shows how the "fish doctor" removes portions of a fin. In all these operations the fish feels little or no pain, and would probably feed placidly if given the chance, while the doctor is cutting.

PRINCIPAL FOOD FISHES OF THE WORLD

Name	Description	Habits	Remarks
Bass (Fresh-water)	A game fish, with short compressed body, greenish with darker markings.	Large-mouthed bass lives in lakes; small-mouthed in streams.	Considering its size, the gamest fish that swims. Protected by law in many states.
Bass, Striped (Salt-water)	Greenish-brown, sides golden silvery with narrow black stripes. Weighs about 100 lbs. on Atlantic sea-coast; 300 or 400 lbs. on Pacific.	Lives in shallow waters in sea, ascends rivers to spawn, prepares nests and takes great care of young.	Important commercially; related to fresh-water bass and with them affords excellent sport to angler. "A gallant fish and bold biter."
Bluefish	A salt-water coast fish; length, 2 ft. or more, weight 12 to 20 lbs., bluish above and silvery below.	One of the most destructive, killing more than it can eat.	As a food fish, has few superiors. Taken by nets and line hooks.
Carp	Fresh-water fish with greenish gray compressed body; sometimes attains weight of 20 lbs.	Dull and sluggish, living near bottom of muddy pools and streams. Can be domesticated.	Not valued highly as food but flesh remains firm long after shipping.
Cat-fish	Smooth-skinned, fresh-water fish, with protective spines on fins and whiskers around mouth.	Abounds in brooks, lakes, and ponds.	All species are good food fishes. Pectoral fin can make an ugly wound.
Cod	Sea-fish with long barbel under chin. Back and sides greenish with brown spots. Average weight 12 to 35 lbs.	Will apparently eat anything. In spawning season abounds on northern coasts of Europe and United States and Canada.	One of the world's most important food fishes. Cod fisheries are an important industry in many countries.
Haddock	Resembles cod, with smaller mouth, dark spot behind head. Black lateral line. Average size, 3 to 4 lbs.; largest 17 lbs.	Found on cod-fishing grounds in large schools; feeds on bottom of the sea.	A valuable food fish; will keep on ice longer than most varieties. "Finnan haddie" (Finland haddock) is smoked haddock.
Halibut	Member of the flatfish family, with both eyes on same side. Dark above and whitish below. Average weight, 50 to 75 lbs.	Has about same geographical range as cod, showing a preference for cold water. Feeds on crabs, mollusks, and other fish.	Most important of flatfishes as a food supply. Food value greater than cod and less than mackerel.
Herring	Well formed sea-fish, thin scales, blue-green above, silvery-white below. Average length 12 in.	Great schools come into shallow water to spawn. Principal food shell-fish.	Most important food fish in world; not used so extensively in America as in Europe.
Mackerel	A perfectly proportioned sea-fish, varying in length from 10 to 18 in., in weight from ½ to 3 lbs. Bluish or green with wavy black stripes on top, silvery beneath.	Travel near the surface of the sea in great schools, sometimes so large as to cover 10 square miles. They feed on small ocean fish.	Caught in nets and on hooks Highly prized for food, both fresh and salted. Spanish mackerel, found along the South Atlantic, are not so abundant.
Muskellunge, or Maskinonge	Magnificent fresh-water game fish, largest member of pike family, often reaching a length of 6 ft., and a weight of 100 lbs. General form that of a pike, dark gray above with blackish stripes on sides on background of silvery gray.	Native to all the lakes of northern United States; comes from deep waters to river to spawn.	Considered one of best food fish, equalling black and striped bass. Usual method of capture is trolling.
Perch	Family of about 125 fresh-water species. Elongated bodies. Colors vary from yellow to blue.	Abound in streams and lakes of Northern Hemisphere.	All varieties rank high as food. Flesh very sweet and appetizing.
Pike and Pickerel	Soft-rayed, smooth-scaled fresh-water fish, bluish or grayish with yellowish-white spots, slender and long snouted.	Noted for remarkable appetites and fighting qualities; terror to smaller fish that share their waters. Found in rivers and fresh-water lakes of North Europe and North America.	Attractive to sportsmen because of gameness and fighting strength. Pickerel means literally a "little pike."

FOOD FISHES OF THE WORLD—*(Continued)*

Name	Description	Habits	Remarks
Pompano	Seafish about 1½ ft. long, slightly flattened, bluish above and silvery or slightly golden below. Average weight, 7 to 8 lbs.	Inhabit the South Atlantic and Gulf of Mexico; vegetable eaters.	One of finest of food fishes, cooked only by broiling. Taken in nets. Few fishes bring higher prices in the market.
Redfish	Game sea-fish, gray with coppery iridescence; sometimes grows to length of 5 ft.	Abound in the coast waters of southern United States.	Esteemed as food fish and one of the valuable products of Texas fisheries.
Salmon	Large fish living in salt and fresh water; nearly 100 species. Brownish above with silvery sides, black dotted; flesh reddish orange.	Ranges northward of Spain in Europe and of New York in North America. The species that live in salt water enter fresh water streams to spawn.	The two principal species of the Pacific coast salmon are the *quinnat* or *Chinook* and king salmon. Among the most valuable food fishes.
Shad	About 30 inches when full-grown, bluish with silver sides. Usually a dark splotch behind gill covers.	Ranges along Atlantic coast from New England to Gulf of Mexico, and ascends rivers to spawn.	Delicate food fish, in spite of many bones. First fish to be protected and artificially propagated by the United States Fish Commission.
Smelt	Small fish related to the salmon, about 12 in. long and silvery in color.	Occurs along Atlantic coast from the Gulf of St. Lawrence to Virginia, and in various northern lakes.	Prized as food because of delicate flavor. When fresh they have an odor resembling cucumbers.
Sturgeon	Large salt- and fresh-water fish; slender elongated bodies covered with bony plates. Long snout, small toothless mouth with thick, sucking lips. Largest specimens 10 ft. long, and weigh as much as 500 lbs.	Inhabit fresh waters and seas of North Temperate zone. Sea species return to stream to spawn. Food consists of small marine animals, sucked into the mouth.	Prized as food fish. Flesh is smoked and their eggs used in the preparation of caviar. Isinglass manufactured from air-bladder. Supply rapidly declining because of slaughter at spawning time.
Sunfish	Several species of small, bright-colored fresh-water fish; grow to 8 in. long and weight 8 ozs	Found in brooks and ponds from Maine to Florida, and in northern part of Mississippi valley; a favorite with boy anglers.	Flesh sweet and tender. Some species clear a circular place in the mud for eggs, which the male protects.
Tarpon	Large sea-fish, somewhat resembling salmon, covered with large silvery scales. From 2 to 6 ft. long and weighs up to 300 lbs.	Found in West Indian waters and off the southern Atlantic coast. Noted for its gamy spirit when caught on hook and line.	Flesh is not highly considered as food; scales are used in ornamental work.
Tilefish	Sea-fish about 3 ft. long, weighing 30 lbs., marked with brilliant spots of yellow. Fleshy fin-like appendage over head.	Abundant off the coast of southern New England. First discovered in 1879.	Fish almost exterminated in 1882 when millions were killed in the heavy spring gales. Prized as a food fish.
Trout	Fresh-water fish akin to the salmon; includes large lake trout and smaller brook-trout of several species. Minute scales with red or dark mottlings.	Trout live in cold clear streams or lakes with gravelly bottom. Gamy and possess voracious appetites.	Important food and game fish, much sought by anglers. Season is strictly limited by law.
Turbot	Large sea-fish of the flat-fish family; brown above, whitish below, sometimes reaching weight of 70 lbs.	Ranges from the Mediterranean to the coast of Scandinavia Feeds on crabs, sea-urchins and fish eggs. Does not occur on American coasts.	Highly esteemed as food; one of the best of flat fishes.
Whitefish	Common name of a number of fishes, white or pale color, belonging to salmon family; especially to the whitefish of the Great Lakes.	Inhabits lakes of Northern Hemisphere; feeds on insects and minute organisms.	One of the finest food fishes in America. The whiting is a slimmer and smaller salt-water variety of the whitefish.

Playing "NURSEMAID" *to* YOUNG FISH

FISH CULTURE. The vast shoals of cod, herring, and other valuable food fishes early discovered in the coastal waters of North America, together with the abundant fresh-water fishes of the interior, greatly aided the country's early development. But gradually it was realized that if fish were caught in such quantities the supply might shortly be exhausted. Especially was this true of the fishes of the inland streams and those that ascended the rivers from the sea to spawn, as do the salmon and shad. For instance, the catch in the Alaska fisheries in a single year, if loaded on a single train, would require about 10,000 cars, and the train would stretch out over a distance of a hundred miles. A single fish often lays millions of eggs every year, but only a very small percentage of these, in ordinary course, hatch and grow to maturity.

Canada established a department of Marine and Fisheries at Confederation (1867), and the United States took up the work in 1871, when Congress created the office of Commissioner of Fish and Fisheries. Even before that date several of the states had established local commissions. Now there are 70 main and auxiliary hatcheries, situated in all parts of the United States, which distribute every year about 6,000,000,000 young fish and fertilized eggs of the various valuable species. The United States is far ahead of the other countries of the world in fish cultural work, although most of them have established fish commissions. Canada has more than 60 hatcheries, with an output about one-third that of the United States.

Here is one step in handling trout eggs at a hatchery. The eggs are shipped packed in moss and ice, and are laid out upon screens. The screens are then put in hatching tanks, and a new generation of trout is on the way.

In the hatchery of a fish cultural station, the eggs are contained in long rows of tanks and jars, and through these "incubators" runs a constant stream of water. The eggs are sometimes gathered from the spawning grounds, but more often directly from the fish. In salmon hatcheries the fish, some species of which always die after spawning, are killed before the eggs are removed.

On the Atlantic coast and the Great Lakes the fishermen aid in the work. Often the government spawn-takers go with the fishing

TURNING YOUNG FISH LOOSE TO EARN THEIR OWN LIVING

After the hatcheries have nursed young trout to a size where they can shift for themselves, the youngsters are packed in large cans, shipped to the streams which are to be their future homes, and dumped in. They swim away and immediately take up the battle of life, struggling for food, and fleeing their enemies. But the hatcheries have protected them through the most critical period, and so a large proportion of them manage to survive.

TWO FAMOUS FISH NURSERIES

Ponds for rearing young bass at the fish hatchery at Wyethville, Virginia

Equipment for hatching cod eggs in the hatchery at Boothbay Harbor, Maine fleets, and obtain the eggs from the fish that are caught, in this way saving millions of eggs that would otherwise be lost.

When the fish have hatched they can just wriggle through the wire mesh that covers the ends of the tanks, and this allows them to pass out into the "run" where they grow undisturbed. Until the fish begin to feed they are known as "fry"; until they are an inch long, "advanced fry"; from one inch to a year old they are "fingerlings"; and from one year to two years, "yearlings." It is estimated that only 15 per cent of the eggs are hatched on natural spawning grounds, but in the fish hatcheries at least 80 per cent are saved.

The young fish are carried in tanks in specially constructed railway cars to all parts of the country and liberated in waters appropriate to each kind. The eggs also can be sent long distances packed in moss and ice.

The principal fishes in which the Bureau is interested are the cod, haddock, pollock, and lobster of the New England coast; the salmon, shad, striped bass, white perch, and yellow perch of the Atlantic streams; the whitefish, trout, and pike perch of the Great Lakes; the various species of salmon of the Pacific coast; and the numerous trouts, basses, and other food and game fish of the interior waters. The great success that has been attained in this work is due to the long study and careful investigation of the spawning, development, and general natural history of each of the fish handled.

Along the Pacific coast certain streams are closed to the canning industry, so that fish may be unmolested. All salmon canning and salting establishments are taxed by the federal government, but the tax is remitted if a thousand "fry" are returned to the streams for every ten cases of salmon canned. As a result several private hatcheries have been established by canning interests, and every year these return an enormous total of fish to the rivers.

Other valuable aquatic life, such as oysters, lobsters, terrapin, and even sponges, also come under the protection of the Fisheries Bureau. Lobsters would be very scarce were it not for the lobster hatcheries that it maintains and the laws passed by the several states prohibiting the sale of lobsters below a certain size. Fully half the oysters marketed are taken from "planted" oyster beds.

WORKERS *with* TRAWL, NET, *and* LINE

"Paying out" the net is the opening ceremony of the day on a fishing smack. What looks to be a deck-load of coconuts is the net in its storage place, with the wooden floats which support it in the water. A line of the floats can be seen stretching astern.

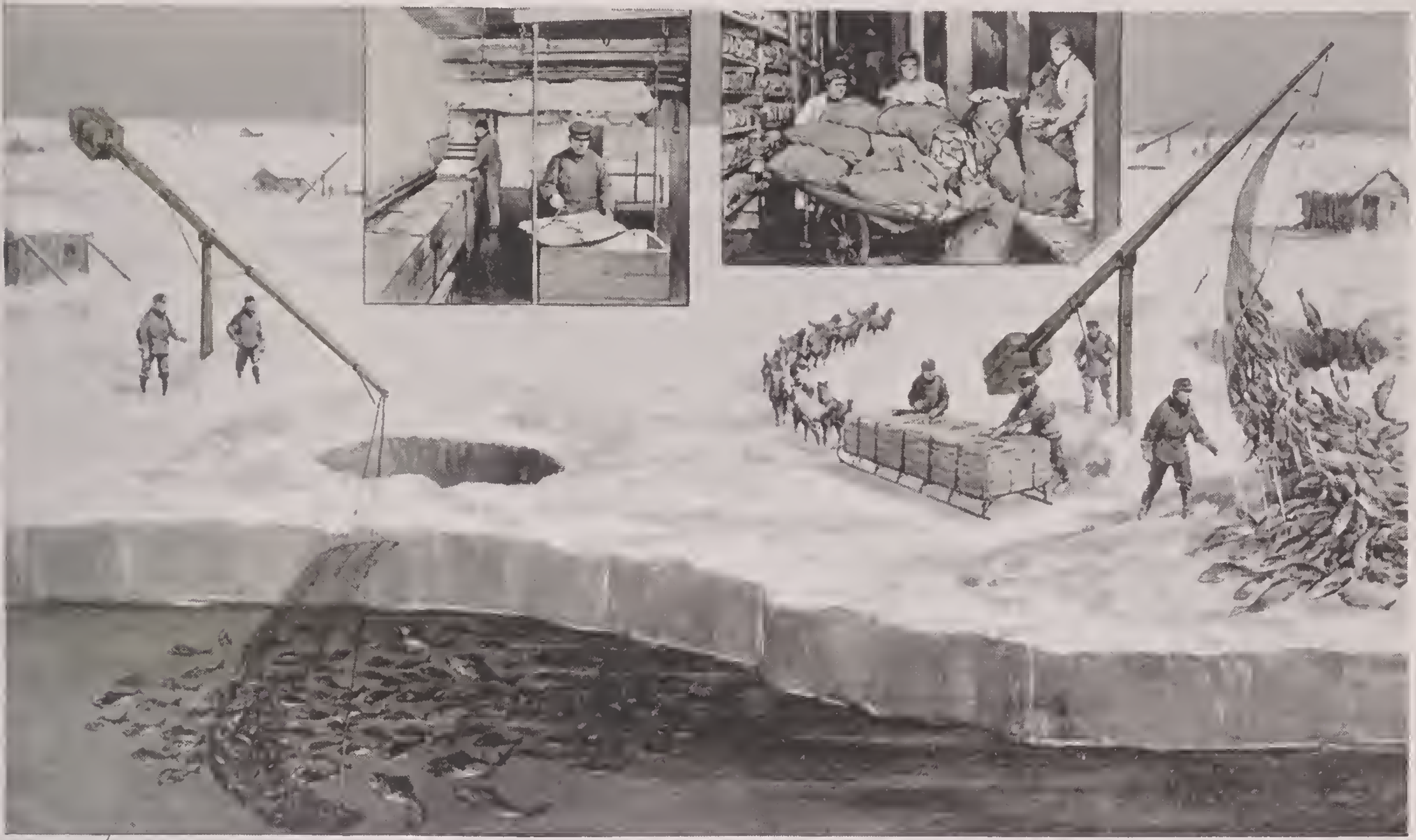
FISHERIES. The "toilers of the sea" have ever been famous as the bravest and hardiest of men, venturing in small craft over the wildest oceans, year in and year out. No more romantic picture can be found than the Breton fisherwomen standing watch each season on the rock-bound coasts of northern France, waiting for the peaked sails on the horizon which tell them their men are coming home—counting these sails, knowing that some will always be missing, peering under their hands for the marks on the canvases that tell the toll of dead, and courageously turning toward the village church to prepare funeral services for those whose bodies lie far away on the Grand Banks of Newfoundland. The hard and dangerous life of the New England fishermen has inspired many a thrilling story, and, indeed, any humble box of salt codfish may have a history to rival the stirring narrative of Kipling's 'Captains Courageous'. The World War of 1914–18 produced no bolder heroes than the fishing crews of the North Sea trawlers, who swept those stormy waters—not for fish but for deadly mines—and whose craft figured so often in the lists of lost or "missing" vessels.

Since the earliest days of history men have fished for their food in seas, lakes, and rivers, and today the catch of the fisherman appears on the dining tables of every country in the world. Fresh fish are boiled, broiled, baked, fried, and even eaten raw, as in Japan, the Pacific Islands, and certain parts of Russia. For future use fish are salted, dried, smoked, pickled, or preserved in cans, and in these forms find their way to places most remote from their native waters.

Trade in fish is of great antiquity. Ponds in which the ancient Egyptians kept rare foreign fish alive until they were ready for use have been found in Northern Africa. A thriving trade in highly prized lampreys and eels was carried on between Rome and distant portions of the empire, and fish are said to have been imported into Italy in those days from points as far distant as the Caspian Sea. The Mediterranean Sea was always famous for its fisheries, but in recent times the European center of the fish industry has moved to the northern countries.

But nowhere are there such great fisheries as those

HOW FISH CATCH THEMSELVES IN THE NORTHLAND



The ingenious arrangement shown above is used on rivers and lakes in Canada to catch fish in winter. The weighted end of the pole is held up by a trigger-like brace, and the net lowered through the hole in the ice. When the net has snared a large number of fish, the force of their tugging sets off the trigger. The weight immediately falls, and whips the loaded net up through the ice. Men then dump out its contents, and allow the fish to freeze. The frozen fish are packed and shipped in ice to market, as shown in the smaller pictures at the top.

of North America, extending from Massachusetts to Labrador and along the Pacific coast. Deep-sea fishing has been carried on in New England waters for three centuries. In less than seven years after Cabot discovered Newfoundland and reported the cod fisheries there, the French sent over their fishing fleets and paid bounties to encourage the industry. Other nations soon followed and the abundance of food fishes had a great influence on the colonization and development of North America.

The term "fisheries" means the taking of all kinds of water products for commercial purposes, and thus it includes the hunting of whales, seals, and other mammals, as well as the catching or netting of true fishes. It includes also the taking of lobsters, crabs, shrimp, oysters, and clams; the catching of frogs, alligators, and turtles; and even the gathering of pearls, sponges, and coral. The countries where fishing is a principal industry are the United States, Great Britain, Japan, France, Canada, Russia, Norway, Germany, and the Netherlands. Nearly all countries with a seacoast, however, have fisheries of more or less value.

How the Oyster Leads the Procession

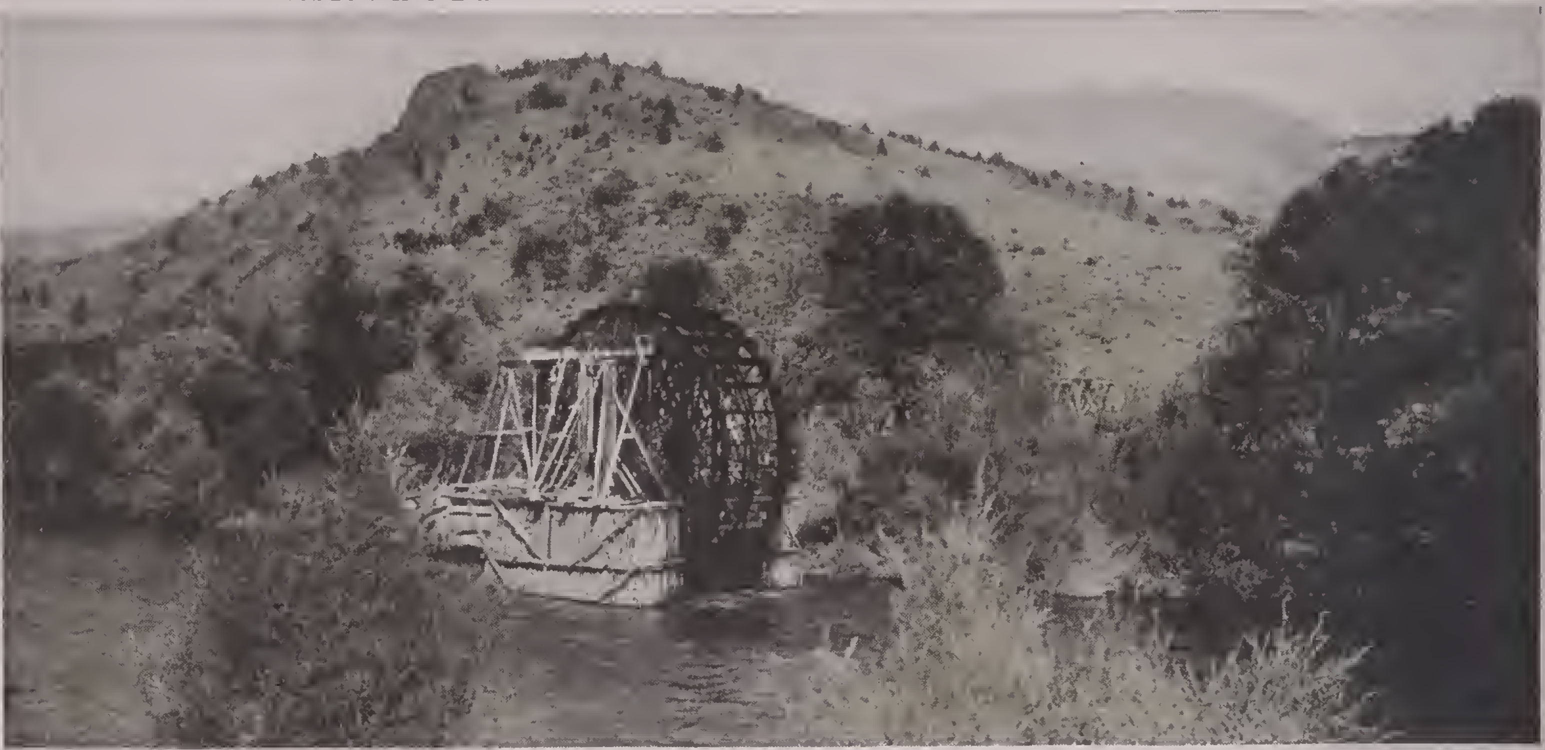
The most valuable product of the fisheries of the United States is the oyster, the market value being about one-sixth the total value of the products of the entire fishing industry (*see* Oysters).

The great fisheries of the New England states have as their chief ports Boston and Gloucester, Mass. Boston is the largest fresh-fish market, while Gloucester leads in salted and dried fish products. The salmon fisheries of the Pacific coast are the most valuable of their kind in the world. The Great Lakes of North America also have the most important of all lake fisheries. Their principal products are whitefish, lake herring, lake trout, pike, and perch. The rivers of the United States are well supplied with fish, especially the Mississippi and its tributaries. These abound in cat-fish, black bass, crappies (a bass-like fish), carp, suckers, buffalo fish, and mussels.

The principal fish taken off the New England coast are cod, haddock, mackerel and pollock, together with hake, cusk, and halibut, which like the cod are all bottom feeders and are found on the shoals or shallow "banks" in the sea. Cod fishing is very perilous. Early in April large fleets of schooner-rigged vessels make their way to the seas off Newfoundland, where the depth is only a few hundred feet. Each ship has a number of small "dories" or flat-bottomed rowboats, manned usually by two members of the crew, who put off from the mother ship each morning. Sometimes in a sudden fog the dories cannot find their way back to the schooner, sometimes they are driven far out to sea by storms, and sometimes a big wave will swamp a boat overloaded with a successful catch.

The fishing is done with hand-lines, with trawl-lines, and with nets. The trawl-lines consist of great

"HARVESTING" SALMON IN THE NORTHWEST



On the Columbia River, ingenious "fish wheels" make the river do the work. During spawning season the salmon come in such numbers that they block navigation. The river turns the wheel, and its buckets dip the thronging salmon up and dump them into a trough. All that fishermen have to do is haul the catch to the cannery.

Meanwhile other fishers are capturing salmon in great nets, and bringing them in barges to the canneries. Here is a barge-load at the dock in New Westmoreland, British Columbia.

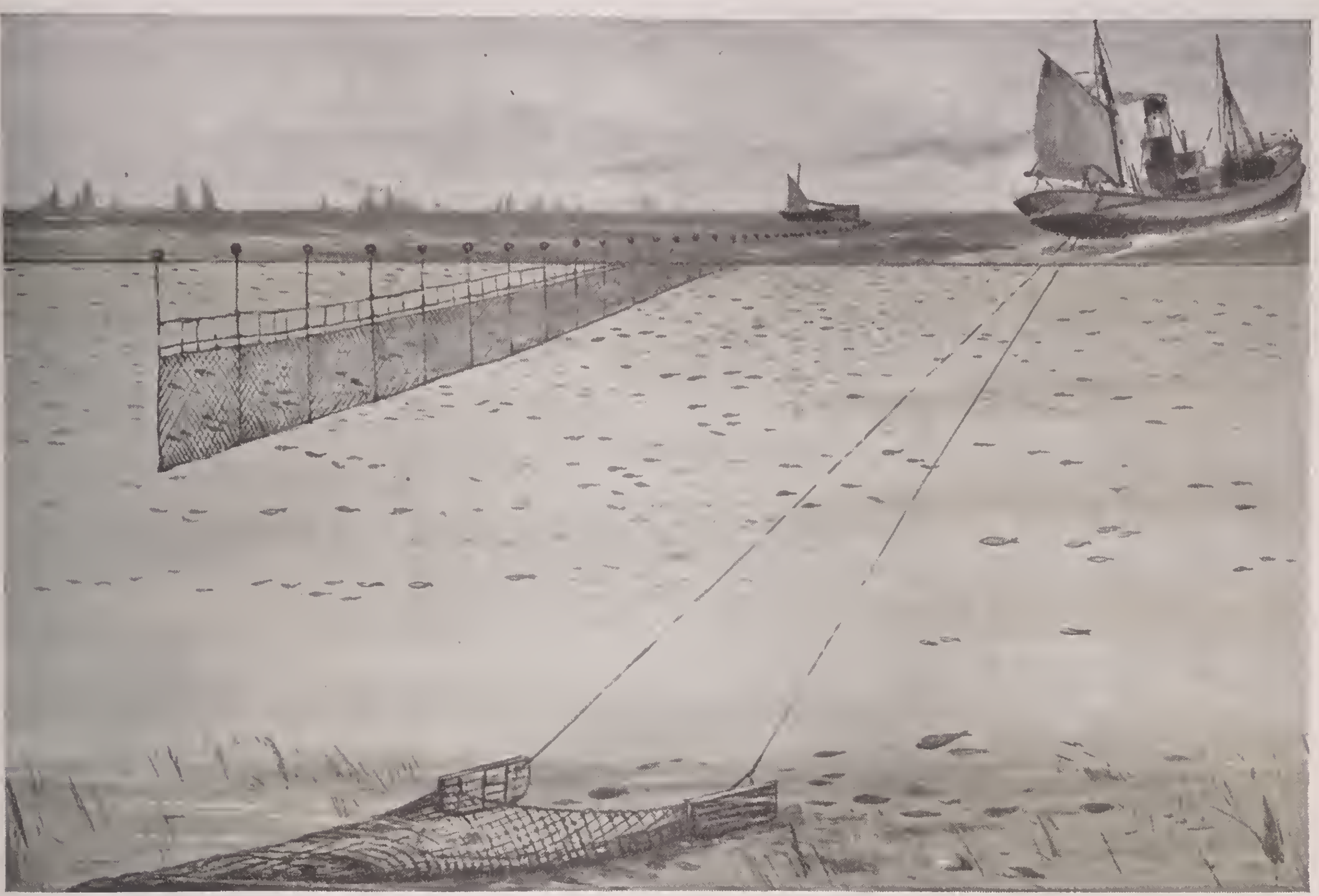
lengths of rope, from which hang numbers of short lines carrying the hooks. These are baited and the whole contrivance is carried to the bottom by anchors. A small buoy with a line running down to the trawl marks the spot. Each dory may set out several such trawls, visiting them at intervals to drag them up, clear them of fish, and rebait the hooks. Usually from 200 to 300 fish are caught on a trawl and on good days the dory may have to make several trips to the schooner to unload.

Sometimes a gillnet is used. This is a net hanging down straight like a screen, the bottom being weighted with lead. The cod swim against the net, and their gills become entangled so they cannot escape. The size of the meshes is fixed by law, so that only the larger fish will be caught. The cleaning and salting is usually done after the day's fishing, and often when the haul is large the men work the greater part of the night. Sometimes a collecting ship takes the haul aboard and steams back to market.

Cod vary greatly in size, ranging from 7 to 70 pounds in weight, but very much larger ones have been caught. One weighing 160 pounds is recorded. They feed largely on clams, which they swallow whole, spitting out the shell fragments after the meat has been digested.

Mackerel fishing is carried on from April until November in the deeper waters from Long Island to the Gulf of St. Lawrence. The mackerel migrates between northern and southern waters. Early in April mackerel "schools" are sighted off the coast of Virginia where they are recognized by the rippling of the water and by the flocks of seabirds which feed upon the fish. They spawn in the shallow waters of New England and the

INGENIOUS WAYS OF GATHERING THE OCEAN'S CROP



At the top is one of the greatest fishing devices—the gill net. The fish thrusts his head through the meshes which are too small to permit the body to follow; then when he tries to back out, his gills catch and he is trapped. This net is simply set out, with floats on top and weights below, and allowed to become "loaded" with fish. Other nets are drawn through the water by the fishing boats. Sometimes the net has a "draw-string" at the bottom to close it into a "purse" when the ends have been brought together. At the bottom of the picture is shown a dredge net, used to scoop up fish and other creatures from the sea bed.

Gulf of St. Lawrence, and in the late fall journey southward again. Mackerel were formerly taken with a weighted hook called a mackerel-jig, but now great purse-seines or gill nets are used just below the surface of the water. The fleets of fishing "smacks" reach the southern fields early in April and work northward.

How Mackerel are Caught in a "Purse"

The purse-seine used for mackerel is a long strip of netting which stands perpendicularly in the water with floats at the top and weights at the bottom. One end of the seine is fastened by a cable to the ship, the other is towed out by small boats, which travel in a circle amid the school of fish, and back to the ship again. The fish are thus caught in a sort of enclosure near the surface. To prevent them from escaping by diving, a rope which passes through rings around the bottom of the net is drawn tight, puckering the lower edges together and forming a basin-shaped purse, which may then be hauled aboard, or from which the fish can be scooped with hand nets.

The most important fish commercially, exceeding even the cod in world trade, is the herring. The leading herring fisheries today are in Norway, Sweden, France, and Scotland, but the industry is growing rapidly on this side of the Atlantic, especially in the waters of British America. The New England fisheries are chiefly confined to Maine. Most of the fish caught there are sold fresh, either for food or for cod bait; the remainder is salted or smoked. Certain species of herring range southward as far as Florida and others are found on the Pacific coast, where they are the object of a rapidly extending industry.

Herring constitute 25 per cent of the yield of all European fisheries. These fish travel in great "schools" closely packed together over areas many miles wide. They are caught in nets and huge traps called "weirs." Large quantities of young herring are packed and sold as "sardines."

The Great Salmon Fisheries of the Pacific Coast

In the extensive salmon fisheries of the Pacific coast the fish are caught when they are entering the streams from the ocean to spawn. The season usually lasts about five months. The fish move near the center of the current, keeping close to the surface, and the fishing is done either by trap-nets, gill-nets, or the deadly fishing wheel. This is a large wheel sunk in the river just below the surface at a narrow place. It has paddles, on the rim of which are set wide-mouthed baskets which turn slowly in the current.

It meets the fish as they swim upstream, lifts them and dumps them into a chute which leads to the shore. The use of the fishing-wheel is regulated by law. Several streams are closed to salmon fishing to keep the fish from being killed off faster than they can multiply.

Another important American sea-fish is the shad, caught chiefly off the Atlantic coast. This fish is highly valued as a delicacy.

Besides the fishes caught for food, many are sought for other purposes. The Chinese catch shark for oil and skins. Many fish like the menhaden or "pogy" are caught for bait, cut up and the pieces put on hooks, or spread over the surface of the sea to lure the fish to the nets. Oil is extracted from the bodies of the menhaden, which in order of weight lead all other products of United States fisheries. Menhaden, however, are not valued as food, and after the fish-oil is extracted, they are ground up and used as fertilizer.

A good idea of the importance of fish to man may be gained from the fact that the annual harvest gathered by the workers with trawl and line is worth more than $350,000,000, without including the catches of India and China. The United States leads in the value of its catch, with Great Britain coming close behind.

WEIGHING THE FISH FOR MARKET

This is the critical step in the story of the long journey of the dried cod from his native depths to the table, for it is here that his value is determined. The cod are captured by hook and line, split and cleaned immediately, and then packed away in salt in the hold of the vessel until it returns to port. There the cleaning is completed, and the split fish are laid out on elevated frames to dry. This process lasts several days, and each fish is turned every day, to insure even drying. When dry the fish, which are stiff as boards, are sold by weight to the merchants who market them throughout the country. Sometimes they are shipped whole, but often they go to factories where they are boned and shredded, and the shredded codfish, packed in boxes, is what most of us buy in stores.

Among fresh water fisheries, those of the Great Lakes region are particularly important. They yield every year over 100,000,000 pounds of food fish consisting chiefly of whitefish, lake herring, lake trout and perch. Lake Michigan and Lake Erie produce about three-fourths of the entire catch.

The fish canning and preserving industry supports upwards of 600 establishments in the United States, including Alaska, with an annual product worth more than $100,000,000. Salmon leads the canned fish, with a value for the canned product of over $50,000,000. (*See also* Lobster; Oysters; Salmon; Whale.)

FIUME (*fē-o̤'mĕ*). Probably no question before the Paris peace conference of 1919—and after—caused quite so much trouble in proportion to its inportance as did the disposal of Fiume, the former Austro-Hungarian seaport at the northeastern head of the Adriatic Sea. The Jugo-Slavs claimed it on the ground that it was the natural and necessary outlet to their new state and that it was long a part of Croatia, one of the Jugo-Slav territories. Italy claimed it chiefly on the ground that the population of the city itself (excluding the industrial suburb of Sussak, just across the little Fiumara River) was strongly Italian in numbers and sympathies.

The political situation was further complicated in September 1919, when Gabriele d'Annunzio, a famous Italian poet whose exploits as an aviator in the World War had made him a popular hero, forcibly seized Fiume with the aid of a band of Italian volunteers and held it without the sanction of his government and in defiance of the world. Even after the Italian and Jugo-Slav governments reached an agreement (treaty of Rapallo) in November of the following year, D'Annunzio and his youthful *arditti* held out. Only when the Italian army began a business-like bombardment and siege of the city did the "mad poet" finally yield (December 1920). By the treaty Fiume and neighboring islands became an independent state, the district of Istria went to Italy, and almost all of Dalmatia became Jugo-Slav territory.

The history of Fiume goes back at least to the time of the ancient Franks. It became a part of the possessions of the house of Hapsburg in 1471, and did not pass out of their possession until the armistice which ended Austria-Hungary's part in the World War.

The crooked narrow streets of the old town on the hill contrast strikingly with the broad avenues and handsome squares of the new commercial city along the shores of the picturesque bay. The harbor, begun in 1872, is second only to that of Trieste in importance for the Adriatic. Before the World War the chief articles of import were coal, wine, rice, tobacco, and raw jute; of export, flour, sugar, fish, and lumber. Population, about 48,000, of whom a very large majority are Italians.

PROUD EMBLEMS *of* NATIONAL POWER

"I SWING before your eyes as a bright gleam of color, a symbol of yourself, the pictured suggestion of that big thing which makes this nation. My stars and my stripes are your dream and your labors. They are bright with cheer, brilliant with courage, firm with faith, because you have made them so out of your hearts." This, said Franklin K. Lane, a member of President Wilson's cabinet, is the real meaning of Old Glory, the banner of the United States; for the flag is but a symbol of the nation. Whatever the flag to which you give allegiance, you are, in a very real sense, one of its makers, as you are of the nation for which it stands. In this article you will read something of the history of these emblems for which men are ever ready to yield their lives, and especially the history of the American flag and the observances connected with it.

THE FIRST SALUTE TO "OLD GLORY"
The Stars and Stripes were raised for the first time at Ft. Stanwix. New York, on Aug. 2, 1777.

FLAGS. In ancient times standards of various sorts and materials were used by the Persians, Greeks, and Romans, the brazen eagles of the Roman legions being the best known instance. But it was not until the Middle Ages that cloth banners and flags came into use, partly as a result of the necessity of distinguishing different forces in the Crusades. The emblems on our flags arose in part from the blazonings of heraldry.

Early flags often had a religious character. The banner of early England was the red cross of St. George on a white background, and the present "Union Jack" of Great Britain is formed by combining with this the diagonal white St. Andrew's cross on a blue background, and the red diagonal St. Patrick's cross for Ireland. This national flag of the United Kingdoms of Great Britain and Ireland, in some of its various forms, is flown by representatives of the Empire all over the world and on every man-of-war of the British navy. The colonies use it with the badge of their colony displayed in the center. Thus the Canadian flag has the British ensign in the corner and the Canadian coat-of-arms displayed in the center on a red background.

The story of the origin of the Stars and Stripes of the United States covers the early history of the country. At first the American colonies naturally used the English flag, or colonial banners which differed from it only in color. Gradually, however, new devices appeared, and before the Revolutionary War the colonies had a multiplicity of flags of various designs. One of the most popular of these had on it the device of a rattlesnake with the words, "Don't Tread on Me." A favorite emblem in New England was a pine tree in the middle of a white field, with the motto, "An Appeal to Heaven." Stripes or stars were also used on colonial flags before they were ever thought of for the national American banner.

These colonial flags were used throughout the Revolutionary War by various bodies of land forces; but it became necessary for the navy to adopt a single banner by which its ships might be known. Accordingly the "Grand Union," the first real American flag, was designed, and on Dec. 3, 1775, was unfurled to the breezes by John Paul Jones on his flagship *Alfred*. This flag bore the English crosses of St. Andrew and St. George combined as the "union" in the upper left corner, but differed from the British flag in having 13 alternate red and white stripes, typifying the 13 colonies. The fact that the emblem of the mother country was retained shows that even after the battles of Bunker Hill and Lexington the colonies were hopeful that their difficulties with England might still be adjusted without separation.

Creation of the Stars and Stripes

It was not until a year after the Declaration of Independence that the crosses of St. George and St. Andrew were discarded. On June 14, 1777—a day which is now celebrated as Flag Day—the Continental Congress created the Stars and Stripes by passing this resolution: "That the flag of the thirteen United States be thirteen stripes, alternate red and white; that the union be thirteen stars, white in a blue field, representing a new constellation." When Vermont and Kentucky came into the Union in 1791, the flag was changed to 15 stripes and 15 stars; but Congress ruled in 1818 that the number of stripes would be limited to 13, but that "on the admission of every new State into the Union, one star be added to the union of the flag."

Many accounts have been given of the origin of the Stars-and-Stripes design. The oft-repeated claim that Betsy Ross, an upholsterer in Philadelphia, not only made the original flag but assisted George Washington and others in planning it is now not credited by most historians. Interesting evidence came to light a few years ago, however, which makes it probable that the honor of designing the flag belongs to Francis Hopkinson, a prominent figure of the Revolutionary period. At any rate, he submitted several bills to the government for designing currency devices and seals and "the flag of the United States of America"; and Congress did not deny his claim, although it objected that he was not the only person who had been consulted in these "exhibitions of fancy."

THE FLAG GOES BY

Hats off!
Along the street there comes
A blaze of bugles, a ruffle of drums,
A flash of colour beneath the sky:
Hats off!
The flag is passing by!

Blue and crimson and white it shines,
Over the steel-tipped, ordered lines.
Hats off!
The colours before us fly;
But more than the flag is passing by:

Sea-fights and land-fights, grim and great,
Fought to make and to save the State:
Weary marches and sinking ships;
Cheers of victory on dying lips;

Days of plenty and years of peace;
March of a strong land's swift increase;
Equal justice, right and law,
Stately honour and reverend awe;

Sign of a nation great and strong
To ward her people from foreign wrong:
Pride and glory and honour,—all
Live in the colours to stand or fall.

Hats off!
Along the street there comes
A blare of bugles, a ruffle of drums;
And loyal hearts are beating high:
Hats off!
The flag is passing by!

—Henry Holcomb Bennett.

"THE ETIQUETTE OF THE FLAG"

There are certain rules in regard to the respect to be shown the flag of the United States, which constitute what has been called "the etiquette of the flag."

When the flag goes by, rise if sitting, halt if walking. If you are a man, take off your hat and hold it opposite the left shoulder with the right hand; if a woman, simply stand at attention until the flag has passed.

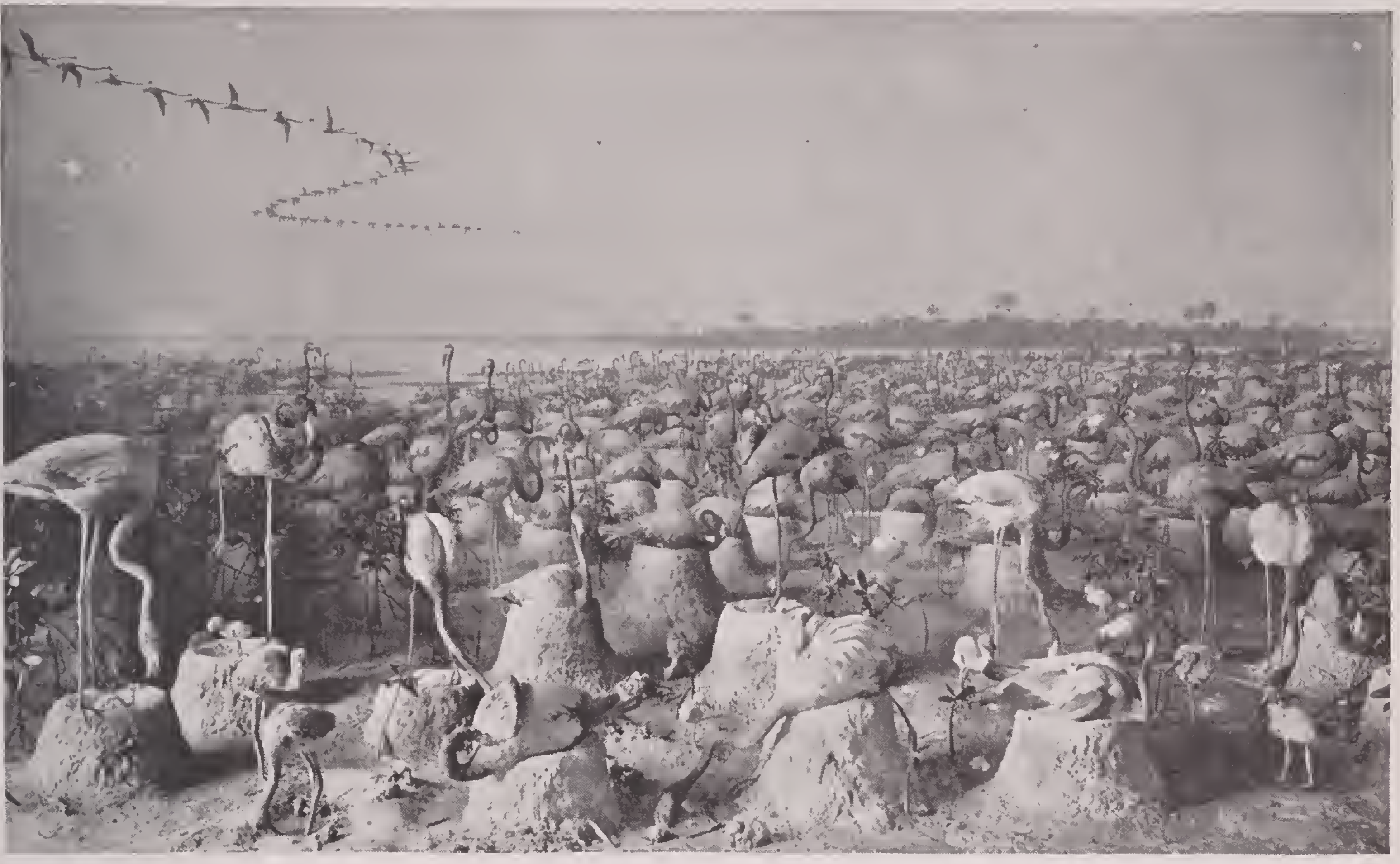
Always stand when 'The Star Spangled Banner' is played or sung; but do not applaud at its conclusion.

Never use the flag for festooning or draping, but use strips of red, white, and blue bunting. Always allow the flag to hang flat, with the blue field in the upper left-hand corner if the stripes are horizontal, and in the upper right-hand corner if they are perpendicular. When the Stars and Stripes is crossed with the flag of a state or another country, it should always be at the right.

The flag should be raised at sunrise and lowered at sunset, care being taken that it does not touch the ground. When used in unveiling a monument it should be carried aloft to wave out during the rest of the ceremony.

No advertising or lettering should be placed upon the flag, nor should it be used as a trade-mark. A flag torn or frayed by the wind should not be hoisted until it has been repaired. Worn out flags should be destroyed, preferably by burning.

FAMILY LIFE IN FLAMINGO TOWN



The day's fishing is done, the mother flamingoes are on their nests, the fathers are standing about gossiping, and the children are playing a few evening games before going to bed. Notice what neighborly birds they are—all crowded together, hundreds and hundreds of them, and yet getting along quite peacefully. Those nests are built of scraped-up mud, with a shallow cup at the top. You can see an egg lying in the third one from the left. In the second from the left is a young one, just hatched. In the middle are several mothers squatting on their homes; one of them is already asleep, with her head tucked under her wing. Another is twisting down her long neck scooping up a bit of food. This picture is from a group in the American Museum of Natural History. The front figures are stuffed specimens, while the background consists of a painting.

FLAMINGO. A more curious combination of beautiful coloring and ungainly form could scarcely be imagined than is presented by the flamingo. A man who had been fortunate enough to see a flock of these great birds on the wing compared it to "a gigantic brilliantly rosy scarf, waving to and fro in mighty folds as it flies away." But a single flamingo viewed at close range is anything but a graceful creature. In shape it is midway between a goose and a stork, ranging when full grown between 5 and 6½ feet in height. Its humped body is supported on legs amazingly long and thin, while its slender neck—limber as a snake—curves upward like a big letter S, and ends in a small head with a great flat down-curving beak.

The lower part of this beak forms a deep broad box, into which the upper part fits like a cover. When the bird is feeding on shell fish or water plants in the shallow mud flats, the neck is twisted like a corkscrew until the head is upside down; then the top of the beak is pushed along through the mud like a scoop shovel, gathering in the food morsels.

There are several species of flamingoes, mostly living in tropical and sub-tropical countries. Of these the most beautiful in color is the American scarlet flamingo (*Phoenicopterus ruber*) occasionally seen in the marshes of Florida and Louisiana. They are far more plentiful in the West Indies and along the coasts from Yucatan to Brazil.

Thousands of these birds gather in remote places during the nesting period. Each female builds a curious mound of mud like a tiny volcano, in the crater of which a single egg is laid. On this the mother sits with legs drawn up like a grotesque statue on a pedestal. The young are hatched in white down with a straight bill, which gradually acquires the crook. (For illustration in colors *see* Birds.) In zoölogical gardens flamingoes often lose their bright colors, but these can be restored by feeding with proper food.

FLANDERS. The name given in the Middle Ages to a thriving district extending along the North Sea southward and westward from the River Scheldt to the Strait of Dover. Parts of Flanders are now included in the kingdom of the Netherlands and parts in northern France; but the greater part lies in Belgium, where about half the people still speak "Flemish," a tongue akin to the language of the Dutch. (*See* Belgium.)

FLATFISH. This is the story of the fish who was scared out of his shape. A long, long time ago, when birds had teeth and the ancient ichthyosaurus swam in the oceans that covered northern Europe, there lived, we are told, a fish that was very tall from top to bottom, but very thin from side to side. He was shaped like the bladder of a football before the air is blown in. He had a small head and narrow mouth so he couldn't fight his enemies, and he hadn't the speed to escape them, nor could he readily hide his strange figure. Yet his flesh was tender and succulent, and he made an easy meal as he floundered through the water with his big flat sides exposed. In fact, he and the members of his family were in danger of being all devoured.

But the story runs that one day one of these young fish discovered he could dodge the swift swoop of his foes by turning quickly on his side and lying flat against the bottom. The result was that he survived to a ripe old age, while the others were killed and eaten. His descendants learned the trick from him and after several thousand years, these fish formed the permanent habit of traveling and resting entirely on their sides.

Presto, Change! when He Lies on His Side

Meanwhile an amazing thing happened. While they were lying on their sides, one eye, of course, lay buried in the mud where it was useless, and the mouth was set at an awkward angle for feeding. We may imagine, then, that for generations these fish tried, while still lying on their sides, to twist their heads around so the buried eye would be out where it could see, and the jaws reach a more effective position. They finally succeeded in part, but their heads would only twist half as far as they liked, and the lower eye was still half buried. So gradually this eye left its place and traveled around the top of the head until it came out on the upper side, next to the eye which was already there. Thus, with two good eyes to watch for danger, these fishes got along very well.

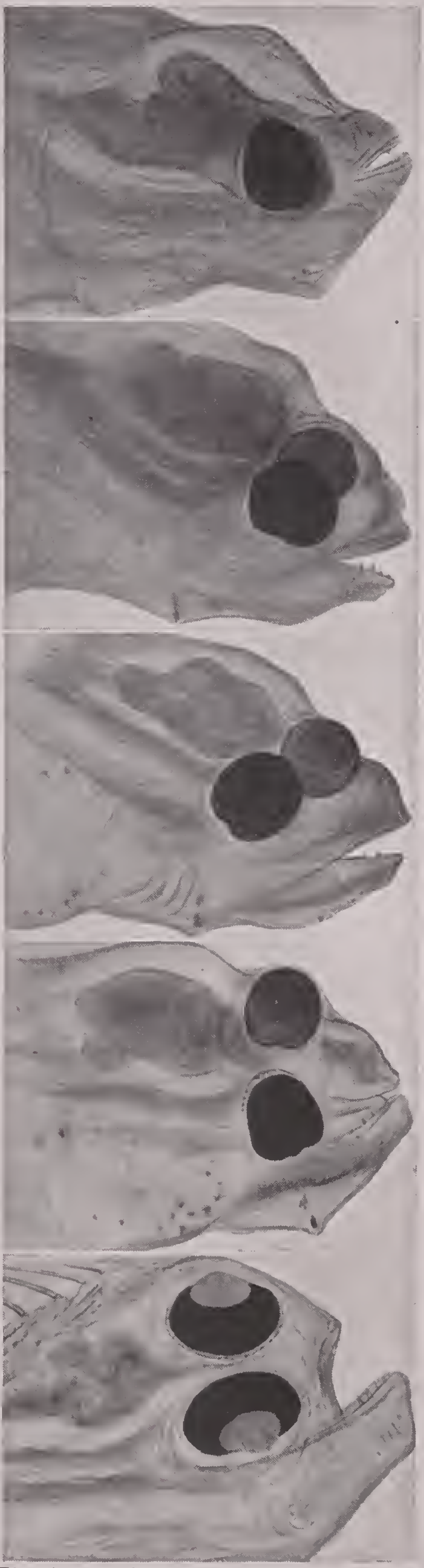
Such is the ancestral history of the modern flatfishes, from the huge halibut to the flounder and the small sole. But although this transformation of shape probably took thousands of years, the young flatfish today inherit the early habits of those remote forefathers who swam upright. When they are hatched from the eggs, these youngsters at first are upright in the water and have an eye on each side of their head. As they grow older, they come to lie on one side and their head begins to twist out of shape; the under eye comes out on top, the mouth turns at an oblique angle, and the whole process of evolution is gone through again in the lifetime of each fish. This is the reason for the strange deformed shape of the flounder tribe.

The flatfish family is a large one, consisting of nearly 500 species. For some mysterious reason, a few of these lie on their right sides, but the great majority prefer the left. The under side, which is not exposed to the light, is whitish, while the upper is usually dark colored. However, this color-scheme, which is designed to make the fish invisible to his foes, changes with the surroundings. For instance, if a flounder is put in an aquarium with a glass bottom through which light is allowed to shine, the under side will turn brown. (*See* Protective Coloration.)

Varieties of Flatfish

Almost all flatfish are valued highly as food. The European sole is considered by many the most delicious of all fish. Some of the flounders found along American coasts are called soles and are excellent for the table. The common flounder or plaice is also a toothsome fish. But the most important of the whole family is the lordly halibut. These grow to an immense size, one caught from the coast of Sweden having weighed 720 pounds. They are considered best, however, at about 100 pounds. Large halibut fisheries exist on the coasts of the United States, and the shipping of halibut from the western centers is an important business. A train called the "halibut express," com-

THE "TRAVELING" EYE!



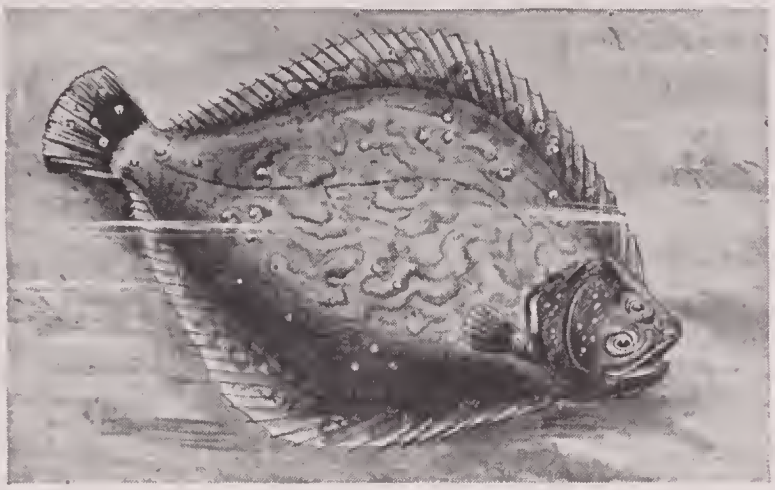
The pictures show how one of the eyes of the flatfish travels from one side of his head to the other, as the fish grows up. The fainter eye is on the other side in the top picture, just coming "over the top" in the third, and in final position in the bottom view.

posed of refrigerator cars loaded entirely with these fish, runs from Vancouver to Boston, making the through trip from the Pacific to the Atlantic in four days, faster than any passenger service.

Other members of the flatfish family are the turbot and the sand dab.

Scientific name of halibut, *Hippoglossus hippoglossus;* of sole, *Achirus lineatus;* of flounder or plaice, *Paralichthys dentatus.* (*See also* Fish.)

THE FISH THAT CHANGES SHAPE



This English Flounder swims upright in early life, but on his side when grown. Thereupon his mouth twists and the "under eye" comes to the top side, thus giving him a twisted head.

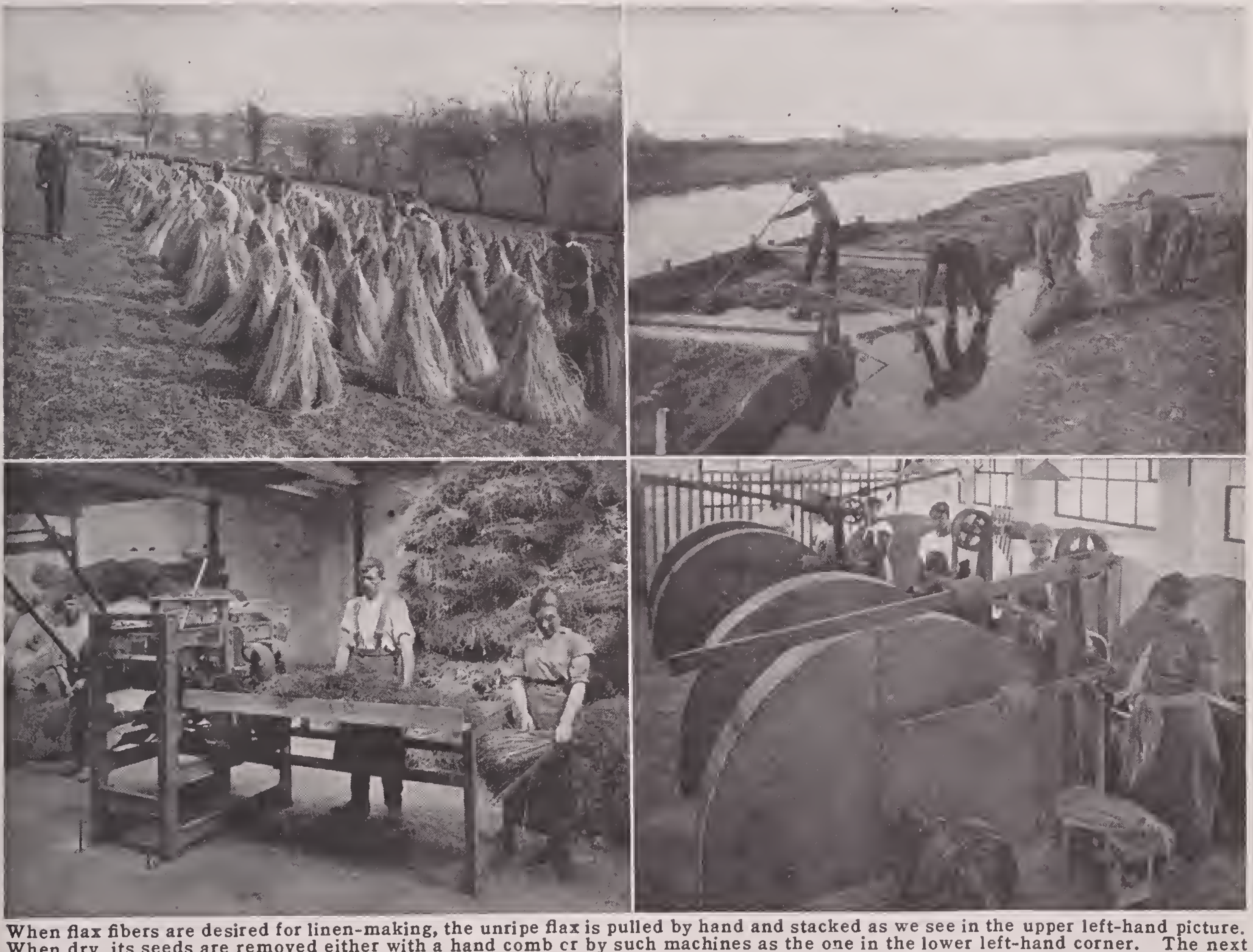
FLAX. A field of common flax in full bloom is like a great lake of delicate blue. It ripples softly as the dainty blossoms, like mountain bluebells, sway and nod to every breeze.

These pretty fields are cultivated both for the dark-brown seed and for the soft strong fiber of the flax plant, which is two feet or more in height.

Each bushel yields from 17 to 20 pounds of "linseed" oil, which is used for mixing paints, making printer's ink, patent leather, linoleum, and oilcloth. The oil cake is a by-product highly esteemed for fattening cattle (*see* Fats and Oils). The fiber is, next to cotton, the most generally employed textile in the whole range of vegetable fibers. From it is produced linen, so widely used in making choice tablecloths and napkins, towels, handkerchiefs, exquisite laces, and a great variety of other articles (*see* Linen).

If only the flax seed is to be used, the crop is harvested with a mower after the seeds are ripe and brown. But if the fiber is to be used the plants must be pulled by hand before they are quite mature. The pulled flax is then

GLIMPSES OF IRELAND'S FAMOUS FLAX INDUSTRY



When flax fibers are desired for linen-making, the unripe flax is pulled by hand and stacked as we see in the upper left-hand picture. When dry, its seeds are removed either with a hand comb or by such machines as the one in the lower left-hand corner. The next process is "retting," or allowing the pithy core to rot in water. Retting in stream water is shown in the upper right-corner. The last picture shows "scutching," in which machines break the rotted pith from the stem and leave the fibers to be heckled, or combed.

tied together in bundles and left upright in the field until it is dry, when the seeds are separated from it; or the separation is made right after pulling, with an iron comb, called a "rippler."

Next the flax is "retted" or soaked by various methods, usually in tanks, pools, or rivers, until through the action of bacteria the fiber is loosened from the decaying woody part of the stalk; it is then spread out on the grass to bleach and dry. The pure fiber is next freed from the core by two operations—"breaking" (cracking the woody portions of the stems), either by hand or by revolving grooved rollers; and cut lengthwise by a "scutching blade" or a "scutching machine." Finally, the flax is "heckled," or combed with an iron comb. The short coarse fibers make the "tow" that was sometimes used in making homespun clothes such as Lincoln wore as a youth.

READY FOR THE WEAVER

The bundle is heckled flax awaiting shipment to the spinning mill, where it will be spun into thread for weaving into linen cloth.

The chief flax-growing countries are Russia (which once produced two-thirds of the flax fiber), Canada, Holland, Ireland, Argentina, Egypt, British India, Belgium, Central Europe, and the United States. Flax has been cultivated in Europe since the Stone Age, and in the United States since about 1630. With the increased use of cotton, fine flax culture in the United States and Canada steadily declined, although during the World War of 1914–18 flax fiber rose in value because of the extensive use of linen for the wings of airplanes. Flax is now grown in the United States and Canada chiefly for the seed, and is usually of a different variety from that grown for fiber. North Dakota is the leading flax state of the Union. Flax is very exhausting to the soil and cannot be planted year after year on the same plot without extensive and careful application of fertilizers. In the western states and provinces it is usually the first crop put on newly plowed prairie land.

FLEA. This is one of the most troublesome little tormentors of the insect world. In recent years it has also been recognized as one of the most dangerous, for it spreads the bubonic plague by carrying the germs of this dread disease from rats to man.

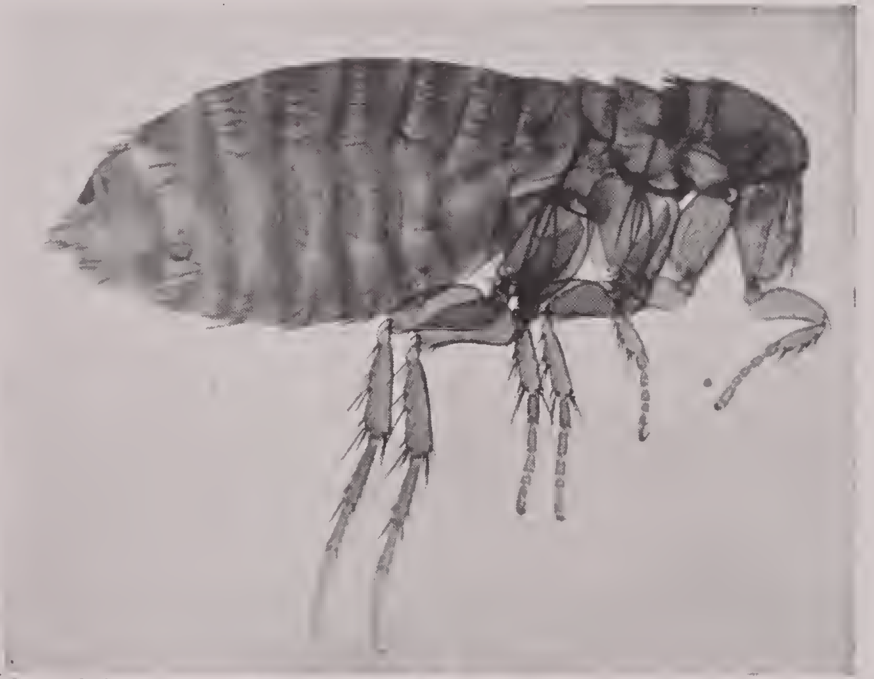
Fleas are very tiny creatures, with their bodies very thin and flattened from side to side (as a fish is flattened). This shape makes it easy for them to slip quickly about among the hairs of the creatures upon which they live. All fleas are what is known as "parasites," that is, creatures which get their living from the bodies of other animals (*see* Parasites).

Fleas have no wings, but they are wonderful jumpers by reason of their long frog-like hind legs. Their heads have a long sharp sucking beak, with which they puncture the skin and suck the blood.

The female flea scatters her eggs about in rugs and carpets and in places where animals sleep. The larvae or young look like little hairy worms; they have biting mouth parts, and live on animal tissues and filth.

Fleas especially infest rats, dogs, cats, rabbits, pigeons, and poultry. There is also a kind that prefers to live upon human beings. This species does not occur in the United States to any great extent, but the dog-and-cat type, which will also attack man if given the chance, is found everywhere. To rid a dog or cat of fleas it should be scrubbed in hot soapsuds and dusted with insect powder, and its sleeping place carefully cleaned.

THE FLEA THAT CARRIES PLAGUE



One of the principal agents in spreading bubonic plague is this Rat Flea, shown greatly enlarged. The details of the process are not completely known, but in general we know that the flea receives the bacillus from infected rats, and transmits it to any person it bites.

Scientific name of dog-and-cat flea, *Ctenocephalus canis;* of common flea of Old World, *Pulex irritans.* There are more than 100 known species of fleas, all parasitic on mammals or birds, and constituting the order *Siphonaptera.*

FLINT. A mineral, a variety of quartz, consisting almost entirely of silica with a little lime, oxide of iron, water, and sometimes carbon. It varies in color from almost black to light brown, red, yellow, and grayish-white, and is sometimes mottled or spotted, but is commonly gray or smoky brown. Flint was largely used by prehistoric peoples to make axes, arrowheads, knives, etc., and until recently to strike sparks for fire-lighting.

The RICHEST GEM *in* ITALY'S DIADEM

FLORENCE, ITALY. "The most beautiful and most famous daughter of Rome," as Dante called his beloved Florence, lies on the banks of the Arno in a fertile valley beyond which tower the rugged peaks of the Apennines. On all sides low hills covered with villas surround the city, which in Renaissance times was the artistic and intellectual capital of the world.

"WHO can describe the enchanting view of this art-city of Tuscany and the world?" says a noted German historian. "Here everything betrays the work of generation after generation of ingenious men. Like a water-lily rising on the mirror of the lake, so rests on this lovely ground the still more lovely Florence, with its everlasting works and its inexhaustible riches. From the bold airy tower of the Palace, rising like a slender mast, to Brunelleschi's wondrous dome of the Cathedral, from the old house of the Spini to the Pitti Palace, the most imposing the world has ever seen,—all are full of incomparable grace. Each street of Florence contains a world of art; the walls of the city are the calyx containing the fairest flowers of the human mind;—and this is but the richest gem in the diadem with which the Italian people have adorned the earth."

From these hills about Florence the scene is one of striking beauty. In the heart of the city rises the amazing dome of the big 13th century cathedral, and by its side is the exquisitely beautiful "campanile" or bell-tower built by Giotto. Near by is the baptistery, with Ghiberti's celebrated bronze doors. Encircling this striking group lies the ancient city—palace upon palace, church upon church, with narrow winding streets and plazas, and low, sharp-roofed dwellings in between. Farther out the newer quarters of the city stretch in all directions, with their pleasant boulevards, villas, and gardens aglow with the profusion of blossoms which have given Florence the name of the "city of flowers."

No End of Famous Names and Places

Every tower and every roof-tree in the old part of the town has its history. The narrow streets of this proud mercantile republic were filled for four fierce centuries with the conflicts of Guelf and Ghibelline, of the Neri (black) and the Bianchi (white) Guelfs, of the partisans of the Medici and the defenders of the republic. In such and such a house Dante lived, and over there Petrarch wrote one of his many sonnets to Laura, his lady love. Here Michelangelo carved his famous statue of the youthful David. There Leonardo da Vinci learned to paint. In the great public square before the civic palace Savonarola, the statesman-friar, died in flames amidst the jeers of the populace. From this spot a short walk will lead to the house of Vespucci, famous as the home of the Amerigo Vespucci who gave his name to the continents of North and South America.

Ths list of famous places and famous names is almost endless. Florence, the birthplace of the Renaissance, was not only Italy's capital in arts, but in science, literature, and statecraft, in skilled trades and in commerce.

Today the shrewd and enterprising qualities which made the early Florentines leaders of Italy are still in evidence. The modern Florentines carry on a lively trade in woolens, keeping up the tradition of the celebrated Woolweavers' Gild, the most powerful of all their great gilds in the Middle Ages. Silks, wood products, and, above all, objects of art form a large part of the retail commerce of the city.

No other Italian city except Rome attracts so many art lovers each year. Its two famous picture galleries, the Uffizi and the Pitti, both former palaces of the Medici, contain collections of priceless value. Almost every church in Florence has famous frescoes on its walls, while the tombs of the city's great men are embellished with notable sculpture. Michelangelo's famous statues over the tombs of Giuliano and Lorenzo de' Medici, in the church of San Lorenzo, are among the world's masterpieces.

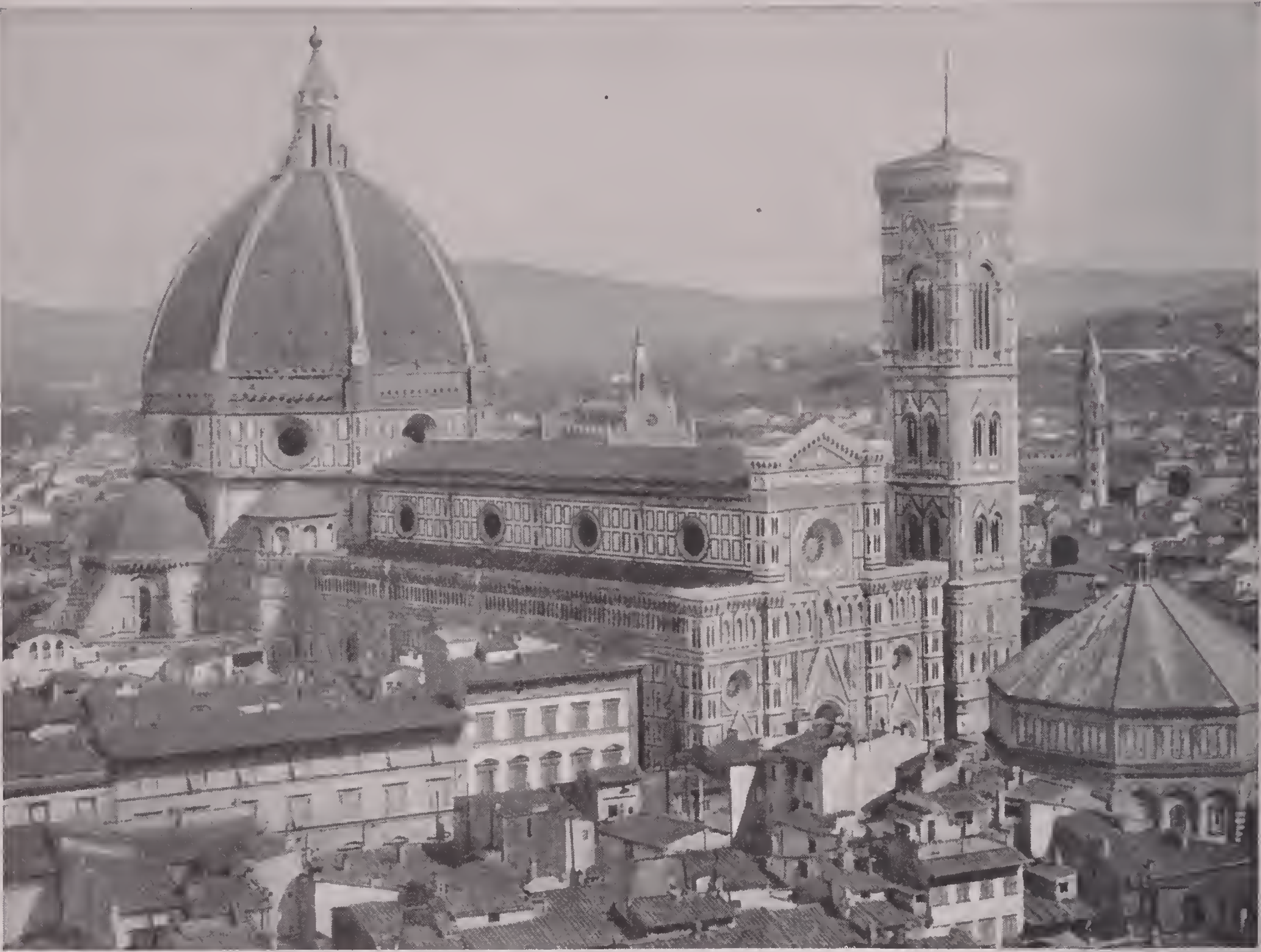
Troubled History of the City-State

Though there are traces of the city's existence as early as the 2d century B.C., its real career did not begin until the year 1115, when Florence became free from the margraves of Tuscany, who represented the German emperor. Almost immediately began the struggle for power between the Guelfs and the Ghibellines, partisans of pope and emperor, respectively. In 1215 members of the powerful noble family of the Uberti murdered a member of the Buondelmonti family, and started a factional war which lasted 50 years.

The Guelfs, aided by the pope, prevailed in the main until 1260, when their army was almost entirely annihilated at the town of Sienna and their leaders were forced to flee. Florence remained in Ghibelline hands until 1266, when Charles of Anjou, champion of the pope against the Hohenstaufen emperor Frederic II of Naples and Germany—"the wonder of the world"—came over from France and smashed the Hohenstaufen forces at the battle of Benevento. The Guelf exiles thereupon returned. Then in 1293 came the famous Ordinances of Justice excluding from office all persons (nobles usually) who were members of the gilds into which the Florentines were divided according to their trades and occupations. For about 150 years the city was then a republic, but with all power concentrated in the hands of the wealthier 5,000 of its 100,000 citizens.

Well might the Florentine historian Machiavelli say, in reviewing this troubled period: "At first the nobles were divided against each other, then the citizens against the nobles, and lastly the citizens against the populace; and it often happened that when one of these parties got the upper hand it split into two. And from these divisions there resulted

LOOKING ACROSS THE HEART OF FLORENCE



From the cupola of the Church of San Lorenzo we are looking southeastward over Florence. Immediately before us is the great Cathedral, upon which a succession of famous architects labored for nearly 200 years. The people of Florence voted to build it in 1294, and the work began. But 124 years later no architect had yet been found who would undertake the gigantic task of putting up the dome. A competition was held in which the genius of Filippo Brunelleschi obtained the victory. Fourteen years he took to build the cupola alone; and the lantern tower above, whose tip rises 300 feet from the street, was not completed until 1462. The famous Campanile or bell-tower next the cathedral was designed by Giotto. The low eight-sided structure at the right is the Baptistery, noted the world over for its bronze doors designed by Ghiberti.

so many deaths, so many banishments, so many destructions of families, as never befell in any other city of which we have record."

As a result the city gradually fell into the power of the trading and banking family of the Medici—not by force of arms, as in Milan and elsewhere, but by corruption and political management. Cosimo de' Medici (1389–1464), the first to take control, held no office or title, but—much like an American political "boss"—he ruled the city by the power of his wealth, his connections, and his personality. Under Lorenzo the Magnificent (1469–1492) the Medicean power and splendor reached its height. The 14th century was the age of Dante, Petrarch, and Boccaccio, the great period of Tuscan literature which shaped the modern Italian language, and the dawn of Renaissance art. Now classical learning was revived in all its branches, and every art and science flourished. Michelangelo, Leonardo da Vinci, Botticelli, are products of this wonderful period.

At the death of Lorenzo, Fra Girolamo Savonarola began his crusade in Florence. Luxury had undermined the morals of the city and this Dominican friar undertook to reform it and restore the city republic. He was so successful at first that the Medici were expelled and many books and works of art were burned in public by the citizens. Savonarola was virtual ruler until he incurred the wrath of the pope and was excommunicated and burned in the Piazza della Signoria in 1498. (*See* Savonarola.)

Niccolo Machiavelli, the famous historian and statesman, lived in Florence during this period and wrote his celebrated work, "The Prince".

With the restoration of the Medici in 1530 Florence ceased to have a separate history. Its fortunes are merged with those of the Grand Duchy of Tuscany, which in 1743 passed to the Austrian House of Hapsburg. In 1859 the whole of Tuscany was annexed to the newly arisen kingdom of Italy. From 186 until 1870, when Rome was recovered, Florence was the capital of the kingdom. Population today, about 242,000. (*See* Italy.)

The SOUTHERN FINGER of the UNITED STATES

FLORIDA. Like a giant thumb extended southward to meet the bent fore-finger tip of Yucatan, Florida grasps the Gulf of Mexico and holds it secure—the American Mediterranean—against the Atlantic. The eastern coast splintered from St. Augustine down by an almost continuous chain of lagoons, drips off at the tip in a shower of islands—the Florida Keys (*see* Key West).

Extent.—North and south, 450 miles; east and west, 400 to less than 100 miles. Area, 58,666 square miles (3,805 square miles of lakes and rivers). Population (1920 census), 968,470.

Natural Features.—Greatest elevation less than 300 feet. Nearly 30,000 lakes (the largest, Lake Okechobee, more than 1,000 square miles in area). Everglades and cypress swamps; Silver, Wakulla, Blue, and Wekiva springs; St. Johns, Kissimmee, Suwanee, and Apalachicola rivers. More than 1,100 miles of coast line, terminating in the Florida Keys.

Principal Products.—Oranges, grapefruit, and other semi-tropical fruits, corn, cotton, peanuts, hay, tobacco, rice; fish and sponges; lumber and timber products; cigars and other tobacco manufactures; phosphate rock, fuller's earth, and ball clay.

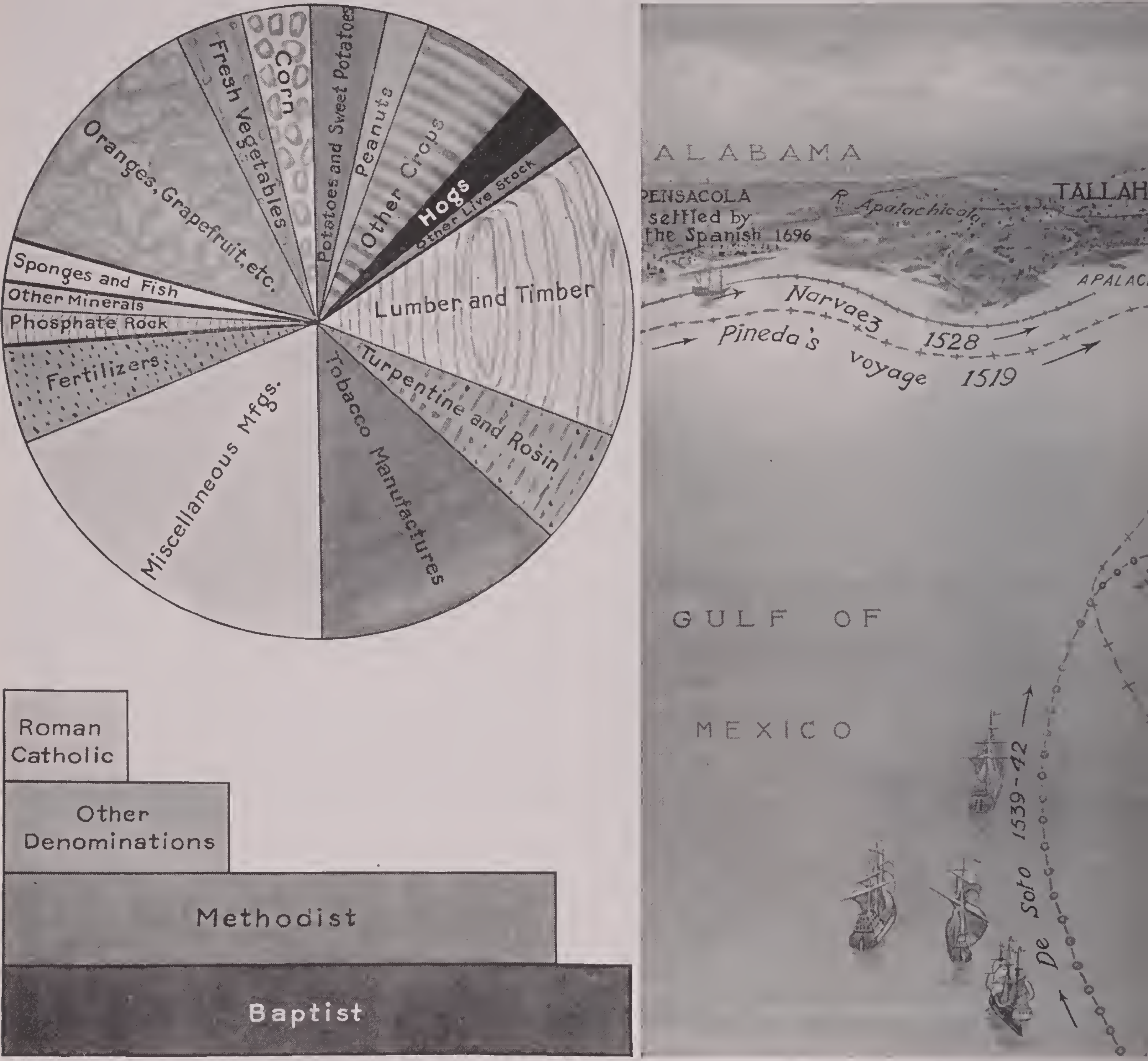
Chief Cities.—Jacksonville (more than 92,000), Tampa (52,000), Pensacola (32,000), Miami (30,000), Key West, St. Petersburg, and Tallahassee (capital).

Its delightful winter climate (60° to 70° F.) makes Florida a world playground comparable to Italy, which the American peninsula further resembles in its long coast line (the longest of any state in the Union, except Michigan) and some of its fruit and vegetable products. Instead of historic ruins Florida has sumptuous hotels; instead of jewel-like old cities and purple mountains, girdled with olive and chestnut groves, the Everglade State has great stretches of thorny thickly matted wild hammock and swamp, where even the Indians wear leather trousers when they go deer-hunting. Florida's blue lakes and leisurely rivers are bordered with slim palmettos, straight and tall like turbaned Seminoles, and its cypress and live oaks, like the forest veterans that they are, wear sweeping beards of hoary gray moss.

Among American states Florida is both old and young. More than 400 years ago, on Easter Sunday (in Spanish, *Pascua florida*) of the year 1512, the Spaniard Ponce de Leon, seeking the fabled Fountain of Youth, first beheld the land, which he named in honor of the day. Following him, De Soto, Ribaut, Menendez, and many another Spaniard and Frenchman came and went, leaving little permanent trace, except for the foundation of St. Augustine (1565), and Pensacola (1696), and the scattering of many saints' names on the map. Through a few fortified posts and missions the Spanish held Florida until 1763, when they yielded it to the British.

British occupation spelled prosperity—actually 25,000 inhabitants. Florida remained in English control during the American Revolution, but Britain ceded it back to Spain in 1783. Florida in foreign hands, being a potential military danger and an actual refuge for pirates, runaway slaves, and criminals, was a grievous thorn in the side of the young American Republic. West Florida was seized in 1810–13, but not until 1819 did the United States procure a treaty with Spain ceding this and the remainder of Florida for the equivalent of $5,000,000. Admission as a

THE PICTURE-STORY OF BEAUTIFUL



In this bird's-eye view of Florida and the "graphs" on the left are presented some of the most striking facts about the products of the state, its physical characteristics, its history, and the relative membership of its principal religious denominations. In the bird's-eye view the arrow on the horizon to the right shows where Ponce de Leon landed shortly after Easter day on "The Island of Eternal Youth," as he thought. Sailing part way around the peninsula as he did later, he supposed he was exploring an immense island and returned to Spain with a report to that effect. In 1519 came Pineda's voyage, and in 1528 that of Narvaez, who in the

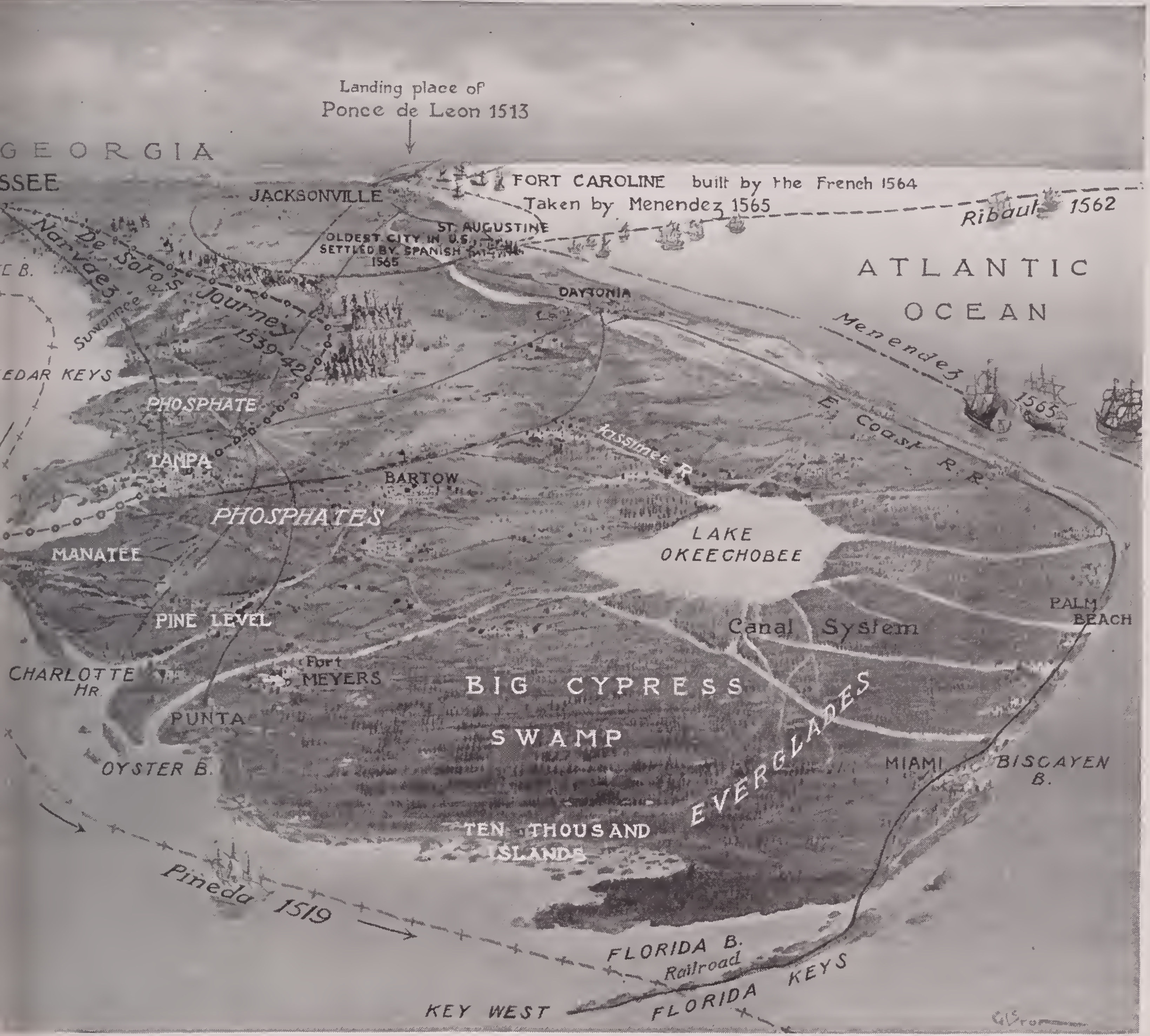
territory (1822), the Seminole War (1835–43), admission to statehood (1845), secession (1861), and reconstruction (1867–68), bring this chapter of earlier history to a close.

Florida's real prosperity begins in 1875, when it was discovered that the gold vainly sought by the Spaniards might be gathered from its orange groves. Today Florida oranges are famous for their quality. A little later (1889) the economic value of Florida phosphate deposits began to be appreciated, and Florida now produces more than three-fourths of all the phosphate used in the United States. But the development of these and other resources hinged on the development of transportation. Even today a railroad map shows Florida scantily equipped in comparison with the industrial states of the North. Yet the state now has more than ten times as many miles of railway as it had in 1880, with inland waterways and roads being rapidly developed.

The Wonderful Railroad over the Open Sea

Truer discoverers of Florida than the splendid greedy Spaniards were two Americans who 30 years ago foresaw what the development of transportation would mean to the country. H. B. Plant consolidated

FLORIDA, IN PAST AND PRESENT TIMES

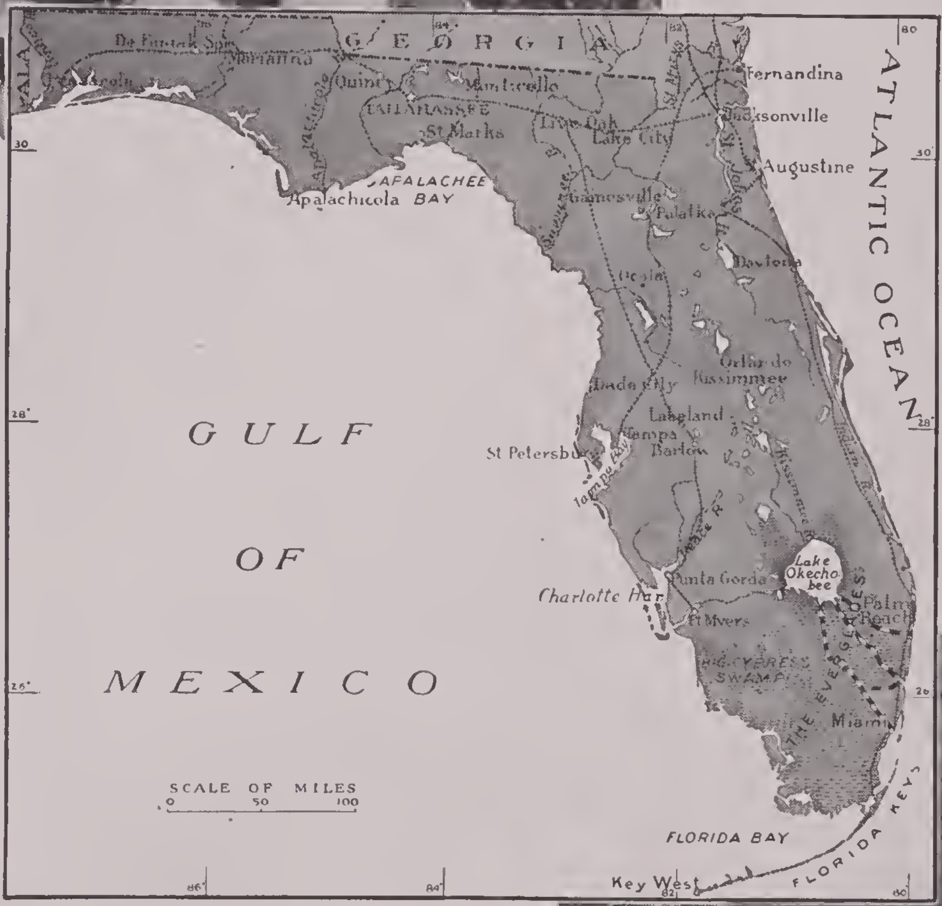


course of his explorations landed at the present site of Pensacola and stayed there for six months, suffering from exposure, hunger, and Indian attacks. He later lost his life in a storm near Pensacola Bay. Between 1539 and 1542 the land was partially explored by De Soto. In 1562 Ribaut, with a band of French Huguenots, landed on the east coast and claimed the country on behalf of France, but three years later the Spaniard Menendez captured Fort Caroline, put almost the entire garrison to death, and founded the city of St. Augustine, which remains today the oldest city in the United States.

and partly built the Atlantic Coast Line; and Henry M. Flagler built the Florida East Coast Line, from Jacksonville and St. Augustine to Key West, a wonderful engineering feat, bridging open sea from key to key for 30 miles, and bringing Cuba within 80 miles of a mainland railway terminal. Another important factor was the opening of inland water transportation from the St. Johns River to Lake Worth, through a system of canals linking up the natural waterways which line the east coast.

With its 58,666 square miles of area, Florida is larger than any other state east of the Mississippi except Georgia. It has a population of nearly 1,000,000, about 40 per cent of which is colored. Its greatest wealth is in its timber (yellow pine and hardwoods), turpentine, rosin, and tar; its fruits (oranges, lemons, limes, grapefruit, pineapples, bananas, guavas, pears, peaches, etc.), vegetables, and other crops, including peanuts, corn, rice, tobacco, and sea island cotton; and its phosphates.

The fish of Florida are valuable not only for food (hundreds of species), but also for sport (notably the silver-scaled tarpon, strong and wild as a Texas broncho). The oyster and sponge fisheries are im-



Here is another map of Florida, showing Jacksonville, St. Augustine, Daytona, Palm Beach, and other cities famous for their gay winter life, when thousands of visitors from all parts of the United States gather there to enjoy the fine climate. Above and below are shown two of Florida's most picturesque products—the grapefruit, which grows in the lower part of the peninsula, and the sponges which are gathered along the coast. Grapefruit grow on trees about 25 feet tall, and these juicy cousins of the orange sometimes reach six inches in diameter. The sponges, as you know, are the fibrous skeletons of sea creatures, which are dragged up from the floor of the ocean, and cleaned and dried for our use.

portant; in fact, the sponge product of the American Mediterranean now exceeds that of the European, where sponges were first harvested, and the largest sponge fisheries of the world make Tarpon Springs their port. Terrapin and green turtle are shipped from Key West. The demand for leather for card cases and valises has so nearly exterminated the alligators that they are now bred for their hides. Florida is also rich in birds and other wild creatures, of which many are remarkable chiefly or solely for their beauty of color or strangeness of form.

Florida has no metals. Apart from phosphates, the principal mineral products are fuller's earth (of which the state furnishes the main supply for the country), kaolin, and ball clay. Perhaps one should add that the health-giving springs are almost as great an asset as a mineral deposit.

Only one state—Louisiana—has an average elevation above sea-level less than that of Florida. Limestone rock (coraline in the keys) underlies the soil, which is basically sand, patched with the comparatively thin vegetable mold of the pine lands and the hummocks and the thick peatlike "muck" of the swamps. Swamps and lakes (more than 30,000 of the latter) abound, Okechobee, on the northern border of the Everglades, being the largest lake in the Southern States. The St. Johns, the most important river, runs its sluggish course for 300 miles parallel with the eastern coast to its mouth near the city of Jacksonville.

The Everglades themselves originally constituted a wilderness area, now in part reclaimed, about the size of Connecticut. The limestone foundation of Florida is here overlaid with a thick layer of rich spongy water-soaked muck, overgrown with tall silver-green sawgrass, netted with outward-flowing streams (not one flows into the 'glades), and dotted with little lakes and ponds and thickly forested dry islands. Deer and other wild creatures inhabit the islands; alligators and turtles frequent the swamps

IN THE LAND OF THE EVERGLADES

Owing to the rich soil, the abundance of water, and the hot climate, the vegetation of the Everglades is very luxuriant—a perfect tangle of cypress, live oak, mangrove, wild lemon, wild orange, and papaw trees, festooned with Spanish moss, while the loveliest of wild flowers, including no end of orchids, are to be seen everywhere. Alligators? Oh yes, there are plenty of them, and crocodiles, too; and there are deer and otters in these wild tangled woods.

THE HOTEL ROYAL POINCIANA AT PALM BEACH

This is one of the magnificent hotels at one of the famous winter resorts of Florida—Palm Beach. The Royal Poinciana is one of the largest hotels in the world. There are a number of other hotels at Palm Beach, including The Breakers which faces the Atlantic. Palm Beach is situated on a peninsula thirty miles long and a mile wide, and the Royal Poinciana faces on Lake Worth, which separates it from the mainland. These hotels are patronized by wealthy people, who swell the population from 1,000 in the summer to 5,000 in the winter.

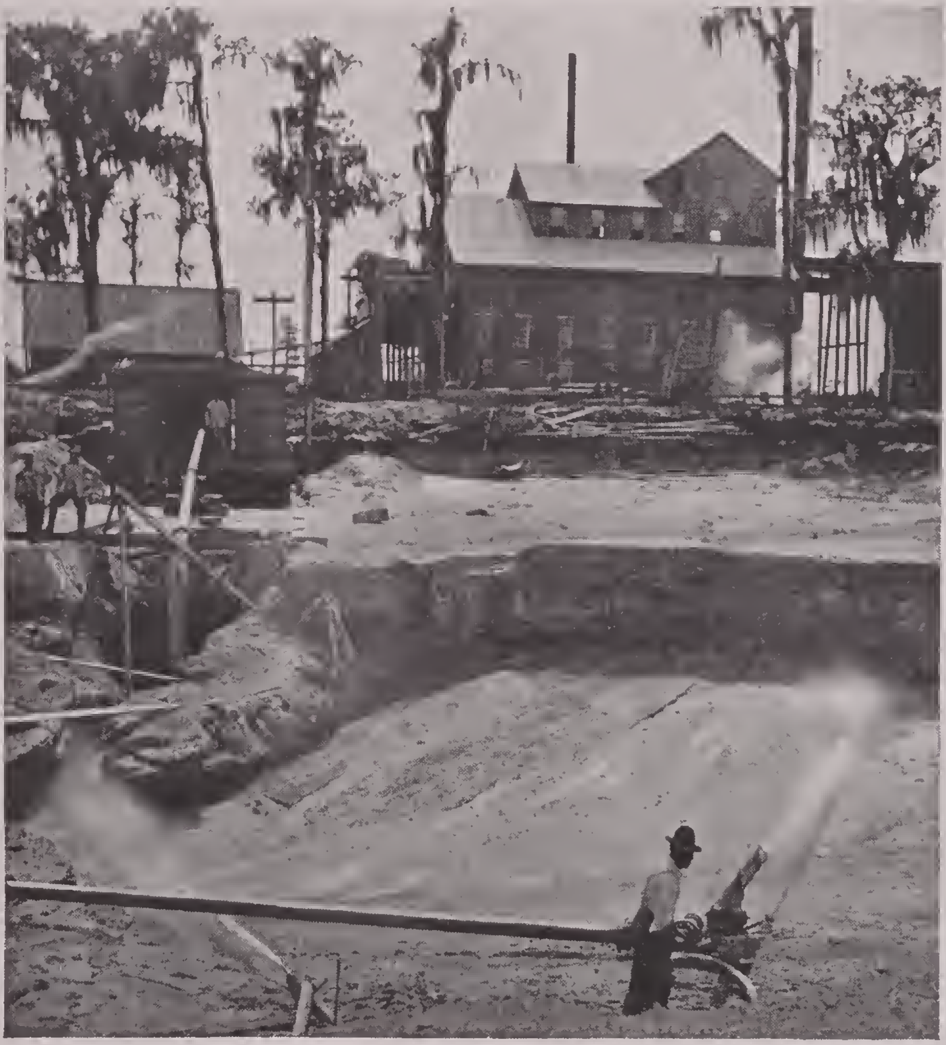
and streams; and egrets, herons, and other birds haunt the watersides and forests. This wilderness even boasts a human population. After the close of the Seminole War in 1842, a few hundred members of the tribe successfully evaded removal to the Indian Territory by flight to the inaccessible heart of the Everglades, a refuge also for white outlaws. Here they have dwelt ever since, hunting, fishing, tilling little plots of the rich island soil, unseen by the outside world except when their few needs send them out to barter herons' plumes or venison for white men's goods.

In 1850 the title to practically all the land in the Everglades was transferred by the United States government to the state of Florida. Following the failure of several private companies, in 1906 the state took up the work of reclamation and began the construction of a series of canals, running from Lake Okechobee to the ocean. The drainage of these swamps will release for cultivation several million acres of the richest lands in the state.

Because modern Florida has drawn many immigrants from the North, its atmosphere and inhabitants are less distinctively "Southern" than those of most other Southern states. Greek sponge-fishers, Minorcan laborers, Cubans, and Bahamans vary the population.

Among the more noteworthy cities are Jacksonville, the industrial metropolis; St. Augustine, the oldest city in the United States; Tallahassee, the capital; Palm Beach, the resort of fashion and the site of one of the largest hotels in the world; Miami, a center for winter tourists and important for grapefruit and truck garden territory; Pensacola, the second oldest city in the state and the finest harbor on the Gulf of Mexico; Tampa, the most important commercial city on the Florida Gulf coast; St. Petersburg, which claims to be the greatest salt-water fishing center in the eastern United States; and Key West, long known as a cigar-making center, but now more important as the southernmost railroad terminal in the United States and closest link with Cuba. Telephone and telegraph cables connect it with Havana. (*See also* Jacksonville; Key West; St. Augustine.)

ONE OF THE FLORIDA PHOSPHATE BEDS



The phosphate rocks of Florida are deposited in veins near the surface and are found in the form of soft phosphate, a whitish product that looks a good deal like clay and has a good deal of clay mixed with it. Phosphate of this character is mined by hydraulic process, as you see from the picture. The deposit in Florida forms a crescent-shaped belt running along the west coast.

FLOUNDER. The name given to a number of food-fishes of the flatfish group, totaling about 500 species. The "summer flounder" or plaice (*Paralichthys dentatus*) is most abundant in the shallow sandy bottoms about Long Island; it may reach a weight of 15 pounds, but is usually much smaller. The "winter flounder" (*Pseudopleuronectes americanus*), found from Chesapeake Bay to Labrador, is about half the size of the summer flounder. Other well-known species are the "four-spotted flounder," and the "diamond flounder," which is the most common species of the Pacific coast. (*See* Flatfish.)

FROM *Golden* WHEAT *to Snow-White* FLOUR

This is one of the great flour mills at Minneapolis. Those rows of immense cylinders on the right are concrete bins filled with grain which is waiting to be made into flour. Elevators like this, in the large centers of flour manufacture and grain transportation, such as Minneapolis and Chicago, have a capacity ranging from 500,000 to 5,000,000 bushels. Port Arthur, Canada, has one with a capacity of over 9,000,000 bushels.

FLOUR AND FLOUR-MILLING. The golden wheat as it comes from the fields must be changed into flour before bread, our principal article of food, can be made from it. The process of grinding the kernels into flour and separating the fine flour from the coarser portions is called "milling."

In early times a stone was hollowed out and a smaller stone, with one end rounded, was used to pound the grain into bits, which were mixed with water and baked on a hot stone (*see* Bread and Baking). Later a hand-mill called a "quern" was used. This consisted of two disks of stone, one on top of the other, with a hole in the middle, through which the grain was fed in. The upper stone was rotated on the lower by means of a handle. Next came large mills made on the same plan, with stones with grooved surfaces to give a cutting edge, and turned by oxen or water-power or windmills. Such mills as these formed part of every great feudal estate in the Middle Ages, and to them the villagers had to go to grind their grist, paying their lord a fee for the privilege. In the early days of the United States boys often rode long distances, perched atop a bag of grain on horseback, to some pioneer mill where the family flour or meal was ground. This system of milling can still be found in primitive communities.

It was not until 1870 that the "roller process" mills, which today grind nearly all the world's flour, were introduced. Rollers made of chilled steel with grooved surfaces break the grain to bits as they revolve on each other. By this method it is easier to separate the various parts of the wheat grain, so that the "patent" roller process flour of today is whiter and better looking than the old-fashioned stone-ground flour of our grandfathers.

Flour made from wheat is used so much more than any other kind that the word flour by itself ordinarily means wheat flour. Other flours are named for the cereals from which they are made, as rice flour, rye flour, etc. Wheat flour contains gluten, a substance which does not occur to the same extent in other cereal grains. It is this which makes dough sticky and elastic, so that it will retain the bubbles of gas formed by yeast or baking powder and thus rise and become light.

IT GROUND THE GRIST OF OTHER DAYS

This is what is left of a granite flour mill which is at least 300 years old. The wooden pulley was turned by a belt driven by a water wheel. The grinder was originally supported by a wooden frame and the grain was crushed between the two stones.

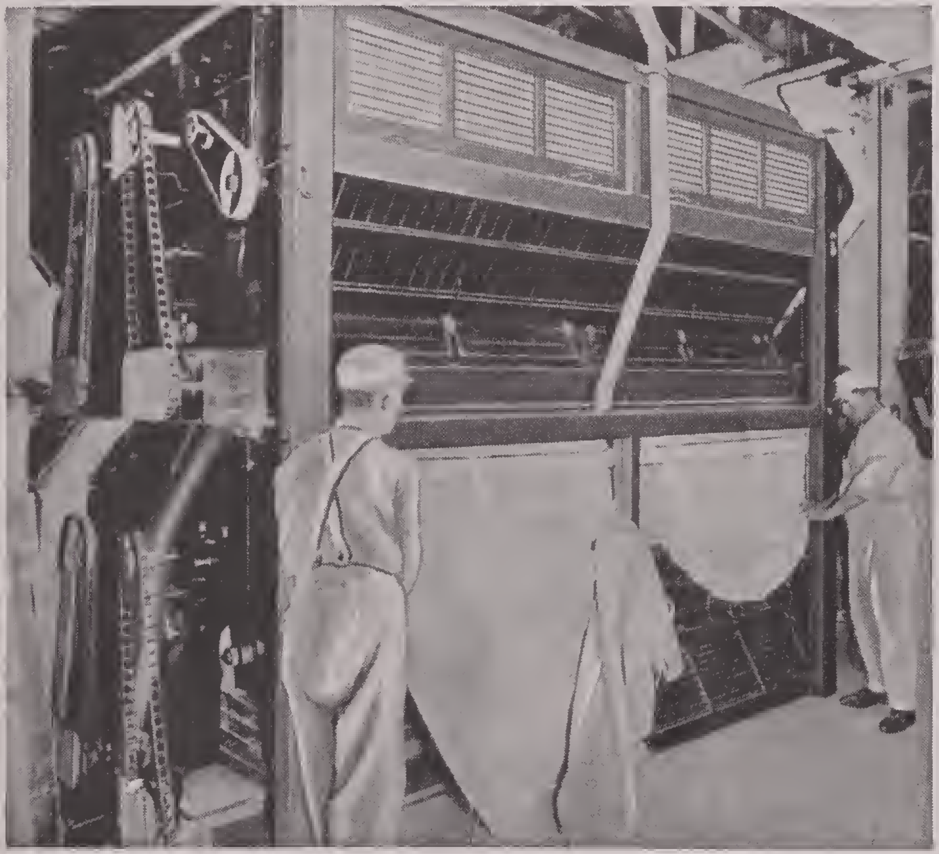
Before we can fully understand milling we must know just how a grain of wheat is made up. We all know that it is an oblong little grain with a furrow down one side. On the outside is the brownish husk, called bran, consisting of layers of woody fiber. Within this husk lies the white kernel, composed chiefly of gluten and starch, from which white flour is made. Tucked away in one end of this kernel is the wheat heart or seed-germ, which, if the grain were planted, would produce the new plant. In the milling, the bran and most of the seed-germ must be removed from the starchy white kernel in order to obtain a fine white flour.

Let us see how flour is prepared in the big modern mills. These are usually eight or nine stories high, and are so arranged that one part of the process is done on one floor and the next on the floor just beneath, so that gravity can be used to convey the grain from one machine to the other.

When the grain first comes to the mill it may contain dirt, particles of straw, and other seeds. These must all be removed before the grinding begins. This is done by sifting and shaking the grain and fanning it with strong currents of air. A special machine removes cockleburs. The wheat grains are scoured bright and clean in a rapidly whirling cylinder. Then they are moistened with steam to toughen the coats of bran, so that when the grains are crushed they will come off whole and can be easily separated. The grain is then dried in a drying room, where an automatic device separates from the flowing stream just enough to make one barrel of flour—about five bushels. Let us follow this five-bushel portion of wheat through the mill.

It drops down one floor after another, each time passing through a set of rollers called "break rolls." The grain cannot

ATTACHING A NEW BOLTING CLOTH



Here we are inside a great modern mill. The men are attaching a new silk bolting cloth to the revolving cylinder of a reel. This cloth acts as a sieve in separating the fine flour from the coarser bits of the grain.

THESE ARE THE BREAK ROLLS

The task of these rollers is to break the shell of the grains, after which they pass on through several other sets of rolls, each adjusted to grind the grain a little finer than its predecessor.

be ground too fine at first, because the bran must be husked off and the seed-germ separated from the valuable kernel of starch and gluten, so each "break" or set of rolls is adjusted to grind a little finer than the one before. The wheat-germ is tough and flattens out instead of being broken to bits, so it is easily removed by sifting.

At each "break" part of the wheat is reduced to fine white flour and part still remains in comparatively large granular bits. The fine flour is separated by "bolting," that is, by passing it through very fine sieves of specially made silk. The "middlings," or the larger bits of the kernels, are then separated from the "tailings," that is the bran and other rejected parts of the wheat, and passed on to another set of rollers to be further reduced. This process is repeated over and over, until all of our five bushels of wheat has been reduced to flour or its by-products. The last machine feeds our flour into a barrel, all ready to go to the bakery or grocery store.

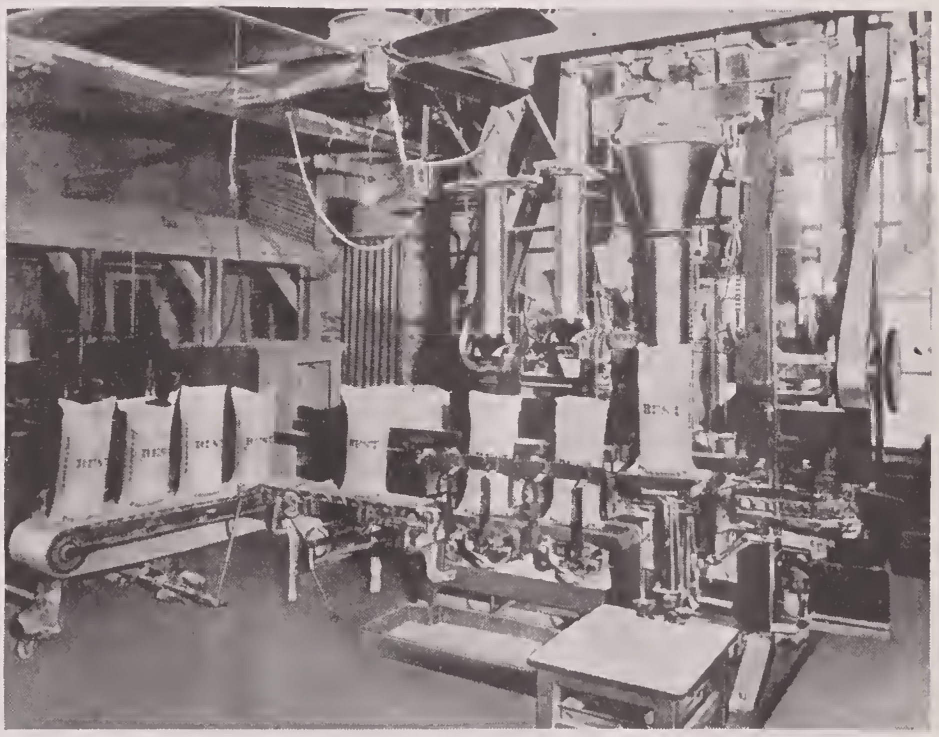
In most flours the bran and the germ are almost entirely removed, but in true graham flour they are retained and ground up fine with the rest of the wheat. This sort of flour is named after Sylvester Graham, who believed that both the bran and the germ contain valuable food-elements. "Whole wheat" flour, as it is improperly called, differs from graham flour in retaining only part of the bran and the germ. Both these flours as they are found in the market usually consist of ordinary flour with bran sifted into it.

Bakery Flour and Home Flour

White flours are usually classified as "straights" and "patents." Straight flours, which are used chiefly in bakeries, contain about 70 per cent of the wheat berry. Patent flours, used chiefly in homes, are so far refined that they contain sometimes as little as 56 per cent of the berry. This sort makes the finest and whitest bread, but it has been deprived of a large part of its food value. The lowest grade of flour is called "red dog," and is used chiefly in stock feeds, breakfastfoods, and in dark breads like rye and "pumper-nickel." "Shorts" is the name given to fine bran mixed with some of the floury portion of the wheat kernel. This is also used in feeds.

During the World War the United States government forbade the making of fancy patent flours, because so much

THE MACHINE THAT SACKS THE FLOUR



When the process of converting the wheat into flour is completed, the job of putting the finished product into the sacks is turned over to the flour packing machines, one of which is here shown. This machine automatically weighs the flour, putting the exact amount required into each sack. And it doesn't even stop there. It sews up the sacks "flour tight"!

of the wheat is wasted. It ordered millers to make only flours containing at least 74 per cent of the wheat berry. Other countries required an even higher standard of extraction. Italy, for example, passed a law that not less than 90 per cent should be used, making what we call the "whole wheat" flour.

There are flour mills in every state in the United States and the production of wheat flour is one of the greatest industries of the country. Minneapolis is the great milling center of the United States and of the world, because it is the gateway between the great wheat fields of the Northwest and the markets, and because it has the Mississippi River to furnish waterpower. There are seven milling companies in Minneapolis with a maximum daily capacity of 85,000 barrels of flour. The Pillsbury "A" mill alone has a daily capacity of 15,000 barrels. Other great flour-milling centers are St. Louis, Milwaukee, Chicago, Detroit, Indianapolis, Rochester, Buffalo, Toledo, and Kansas City. (*See* Wheat.)

"FLOWERS *that their* GAY WARDROBE WEAR"

"BEAUTY is its own excuse for being," we might say of the flowers whose varied forms and gorgeous colors delight the eyes of every beholder. But they need no such excuse, for they are among the most useful parts of the plants which produce them, and their very beauty has its use. For ages plants and insects have been partners; the flowers give the insects pollen and nectar to eat and in return the insects carry pollen from flower to flower, thus assuring cross-pollination which enables the plants to produce stronger seeds. The bees, butterflies, and some moths are the chief insect partners; the humming-bird is also a partner; all of these are attracted by color. Thus it happened that long before man was created to enjoy them, there were flowers of many colors, developed to attract the attention of their winged partners. We might think of the flowers as the plant's advertisements saying in insect language: "Fly right this way and get some pollen and nectar!"

FLOWERS. The brightly colored parts of the flower are usually the "petals"; and it is their business to send forth the color call to their pollen carriers. Many flowers have still another call for help, and that is odor, which we call "fragrance" if it is pleasant to us. Not only have color and fragrance been developed by this partnership, but also the shapes of flowers have been modified for the convenience of the pollen-carriers. The deep-throated flowers, such as the petunia, are fitted for the long tongues of moths and butterflies; the deep nectary of the nasturtium, for the convenience of the humming-bird; the lower lip of the sage flower, for the bee to alight upon. In fact almost all flowers are shaped with reference to securing pollination by some means.

Where the Bees and Butterflies Do Their Work

Since the use of the petals is to attract the flower's helpers, we naturally find the most important parts of the flower set in the midst of the petals. These consist of, first, a "pistil" which is formed of two very necessary parts: the basal part called the "ovary," in which the seeds are developed and perfected, and the tip or "stigma." The latter is a sticky, spongy, usually button-shaped, bit of open plant tissue, which catches the pollen grains and holds them while they send down their tubes to the "ovules" in the ovary, carrying the necessary material to enable the ovules to grow into fertile seeds. Often there is a stem between the ovary and stigma which holds the latter up in an advantageous position; this is called a "style," and is prominent in lilacs.

The second essential part is the one that produces the pollen; it is called the "stamen," and its most important part is the "anther," which usually forms a double pocket in which the pollen grains grow. When the anther is ripe the pockets open, letting out the pollen dust to be carried by insect or wind to some waiting stigma of the same species. But to do this the anther must be in a position where it can be reached by the pollen carrier, thus it is often provided with a stem called a "filament" which holds it up or out advantageously. The pollen grains are so small that they look like dust, but each grain is of a definite form and in some species is ornamented with knobs or markings.

The arrangement of pistils and stamens in different flowers shows an amazing amount of variation. In many of the most familiar garden plants, every part of the reproduction system is found in each flower, the pistil rising from the center, surrounded first by stamens, and then by a ring of petals. Some flowers, however, have just one or more pistils but no stamens and they are called "pistillate"; others have stamens and no pistils, and are called "staminate." Sometimes both pistillate and staminate blossoms grow upon the same plant, and such plants are called "monoecious." In other types, each plant produces only one kind of flower, and plants of this sort are called "dioecious."

The Protectors of the Petals

Thus we see that the special treasure of every flower are the parts that produce the seeds, and that these are usually surrounded by the petals to attract pollen carriers. But the petals are delicate in texture and need protection while growing; and to supply this, many flowers have "sepals," which are more tough and firm than the petals and which completely cover the very young bud. Sometimes, as in the tulip and lilies, these sepals take on the color of the petals as the flower opens; and sometimes, as in the larkspurs, the sepals change to blue and give the color call to insects. But we can always tell which parts of the flower are sepals by noting the outside of the young bud. There are some flowers that are protected in the bud by a leaf envelope like the "spathe" of the daffodil or jack-in-the-pulpit, but most flower buds are protected by some arrangement of sepals.

All of the sepals taken together form the "calyx" and if the sepals are united the calyx may be tubular or cuplike. All of the petals taken together form the "corolla"; and if the petals are grown together, then the corolla may be tubular, as in the morning-glory or petunia. There are some flowers that may lack sepals or petals, and they are called "apetalous"; or the pistils and stamens may be without sepals or petals around them and thus are called "naked."

Clubbing Together to Make a Show

The forms and arrangements of flowers are almost infinite in their variety. Some plants, such as the clovers, geranium, and verbena, have such small blossoms that singly they could not very well attract insects; but growing in clusters they make quite a show. Such flower clusters are sometimes in the form of close "spikes" or "spikelets"; sometimes as "racemes," with the blossoms distributed loosely upon an elongated axis; sometimes in the form of pyramidal clusters (like the lilac), called "panicles," in which the arrangement of blossoms is regular.

The *Compositae* form a large plant family that has taken a step farther and adopted a coöperative plan for its flowers. The tiny florets are set close together in a solid head, those at the center being perfect flowers, while those set in the rim develop long petals of bright colors to attract the insects. The sunflower is a good example; the outside row of florets produce the petals which form the "rays" of the sunflower, while the inside flowers, which are called disc florets and have an abundance of nectar, develop the seeds. The dandelion, goldenrod, thistle, dahlia, chrysanthemum, marigold, cosmos, bachelor's button, and a host of other common flowers are of this sort.

The Life of a Flower

INSIDE a little seed is a power that no man knows. The great forces of the universe are on its side. Sun and wind and rain, night and day, spring and summer and winter, gravitation and the revolution of the earth, the silent transformers of matter and the conscious toil of human hands, are in partnership with this tiny thing; and as a man with a chisel and a stone produces a thing of beauty, so the mysterious relations between the forces of the universe and a seed produce a joy and power forever.

No man can fathom the hidden powers that lie behind a flower. In forming the petals and the stamens the millions of molecules that build up a flower must move in a certain path. Who is it, what is it, that guides each molecule along the one path out of thousands that it might pursue? Who is it, what is it, that takes these millions of molecules, with countless roads before them, and leads them by the right road until first the sepal, then the petal, then the stamens, then the carpel, and at last the whole flower is made? We have seen the mobilization of an army of men, with all the fears and hopes and perils that go in its train; but the molecular army of a tulip is vaster in number than that, and its mobilization never fails.

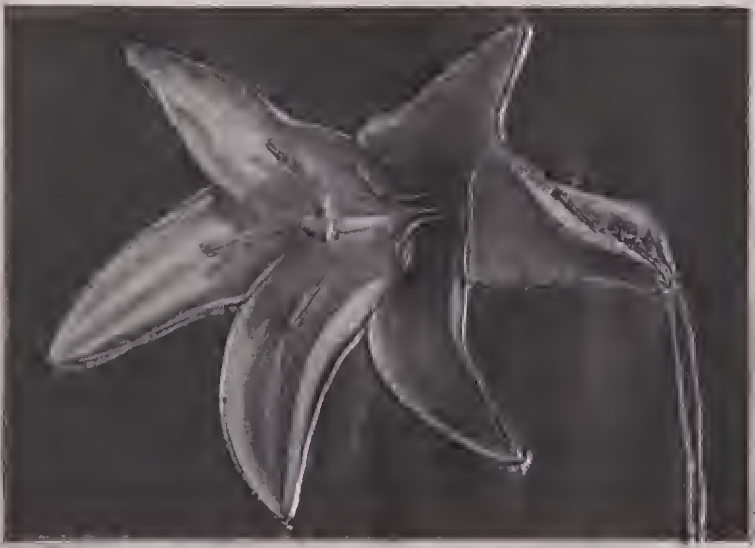
We need go no farther than any country lane for the silent witness of these things; we see on every hand the evidence of the mind outside Creation. But what of the mind within Creation? Plain for all to see, as we look at any country scene, is the design of the Hand of God; but invisible in it all, working in the stem and the root and the flower, in the root of an oak, the egg of a bird, and the burrow of a mole, mind is working too.

See how the intelligence of a plant will work. A blade of grass will turn towards light too faint for the eye to see, and everybody knows how plants go out in search of the things they like. They arrange their surfaces to the best advantage for drinking in the light; the Fittonia plant has a lens-like cell which focuses light so that the plant can receive it from any angle. A root will turn away from certain substances; the root of a cabbage or a pea will grow towards phosphates and turn away from poison. Mosses and ferns will show preference for one substance rather than another; put the sperm cells of moss and fern into water with a little cane sugar and malic acid, and the moss sperms will collect around the sugar and the fern sperms will collect around the acid. The sundew plant will do the same. Let an insect settle on it, and the tentacles of the sundew grasp the insect and pin it down; if there are two insects the tentacles will distribute themselves and pin both down. Give it a grain of sand, of sugar, or a bit of wood, and the sundew will make no attempt to consume it; but give it something it likes and the plant will eat it.

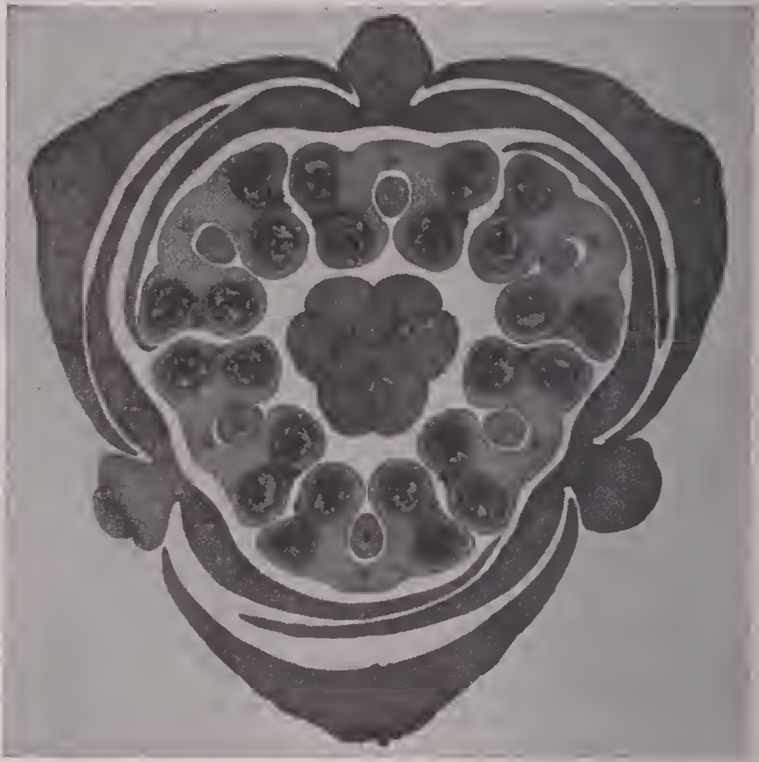
We think ourselves clever at some things, but have you ever thought how clever a root is? Plant a potato too deep, and what will it do? It will correct your mistake for you; it will throw up a new shoot to the proper level and send you a potato from that. Perhaps you have not wondered why a root bores its way as a spiral into the ground, but it knows the best way to its food supply: a spiral root comes in touch with much more soil than a root going straight down. As the leaves go in search of light, so the root goes in search of water; the root of a poplar tree has been known to travel through 30 feet of soil, under a wall, and through the brickwork of a well.

So, as every gardener knows, a plant adjusts itself to the circumstances of its life; if it is rich it lives a life of ease; if it is poor it struggles hard for a livelihood. Let a baby be born in a slum, and the chances are that its life will be very much harder and many years shorter than if it were born in a mansion, and it is simple truth that we can change the life and health and appearance of a plant by changing its environment. It is true, also, of qualities and directions and intensities.

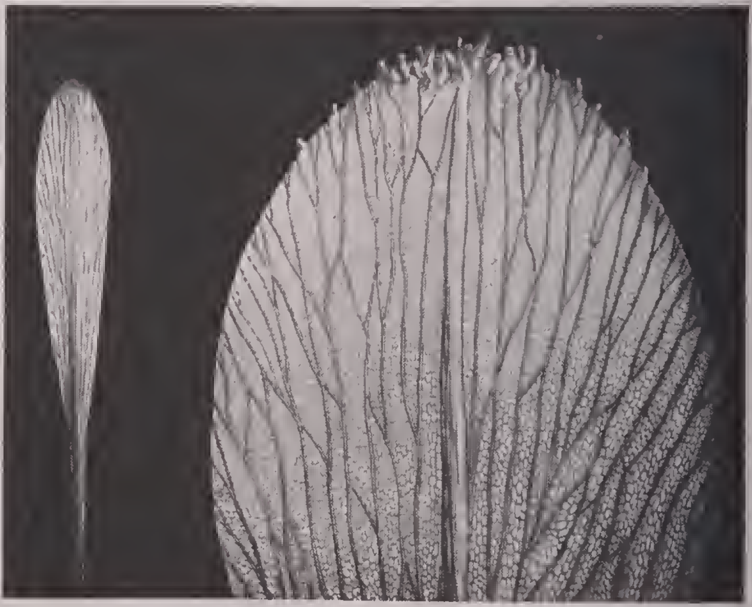
In every garden in America, wherever the humblest flower is grown, a thing is happening that no man in the world can understand. "If I could know you, all in all, little flower," said Lord Tennyson, "I should know what God and man is." It is true. But we do not know the secret of this little thing. The story of a common flower is past the understanding of the mind that can weigh the earth and measure the sun and send the human voice across the sea. Let us go out in the garden and pull a flower and look at it; let us see how a flower works, as we say.



1. This is a Bermuda lily. On the outside are three colored leaves—the sepals; inside these are three other leaves something like them—the petals. Sheltered within these protecting leaves are six slender rods—the stamens; they are something like pins with long double heads—the anthers. In the middle of these six rods are three rather sticky little balls—the stigmas. They rise from a sort of stick, the style, which runs down into a hidden case, the ovary, the very home of life. We shall see the wonderful things that happen in this hidden box, the silent factory in which Life works out its wonders. It is inside the swelling at the end of the stalk.

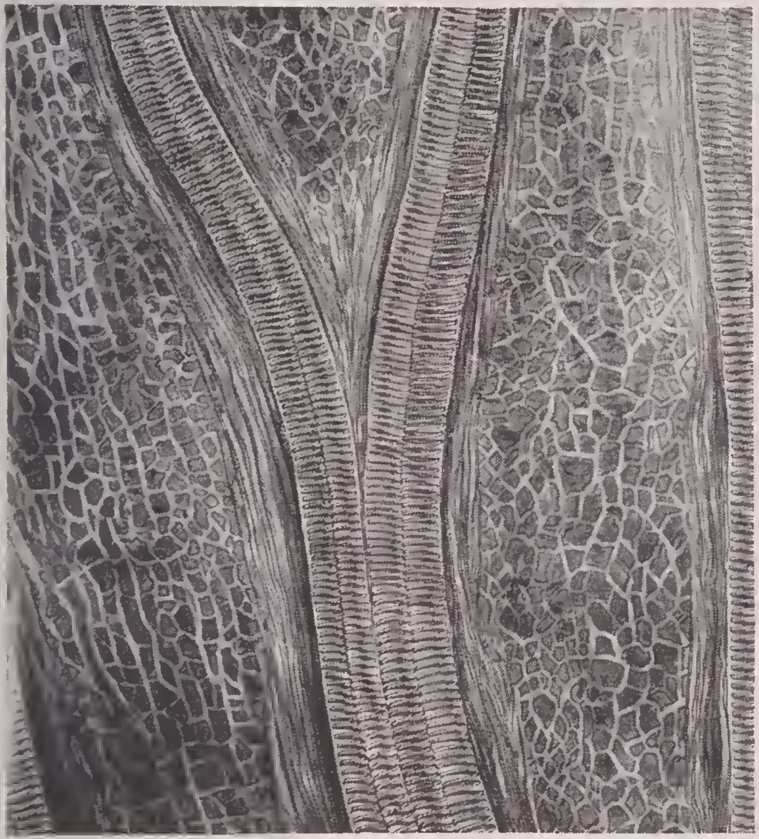


2. The inside of the flower-bud is like this; this is a slice across it. Going into it from the outside we pass three sepals, three petals, and six anthers, and then come to the central style, at the top of which are the stigmas, and at the bottom of which is the ovary, in which the seeds are carried.

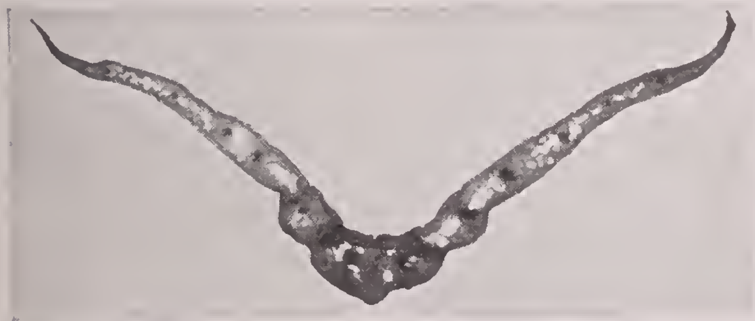


3. Here is one of the petals; on the right is the petal as we see it under the microscope, showing the veins that point the way for the bee when it comes to find the honey deep down in the flower.

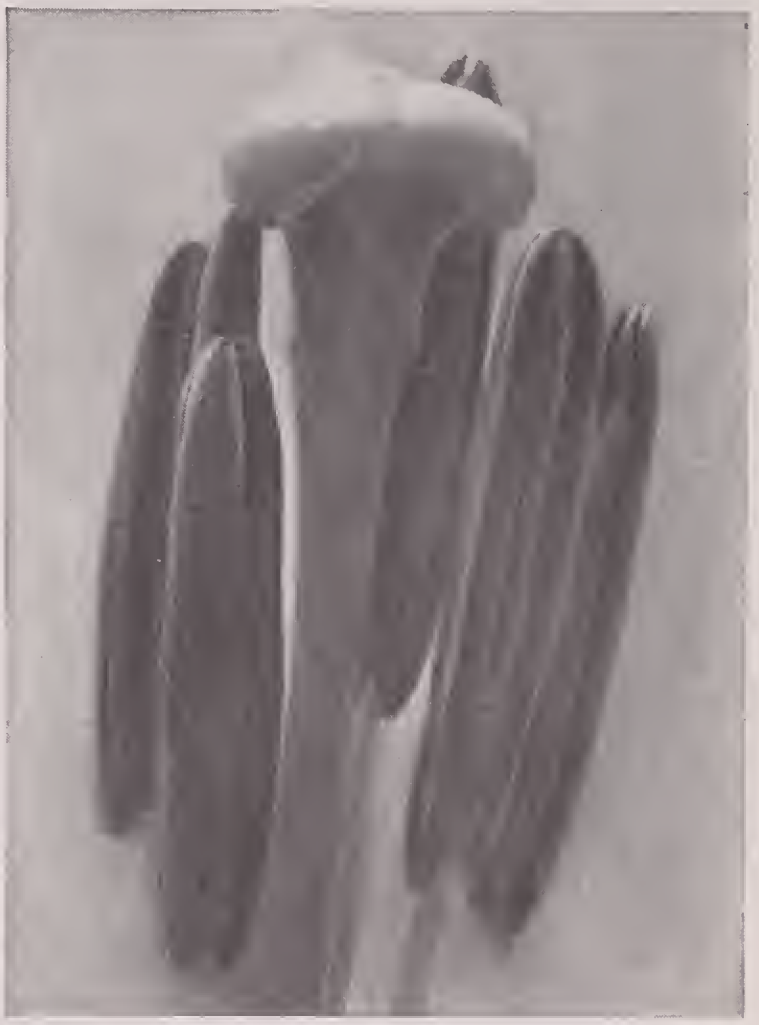
4. Let us look still closer at these petal-tips; their framework is beautifully built.



5. Adding to the power of our microscope again, so that we can see still farther into the petal, we find that these veins are wonderful things. Here, in the middle, is a forking vein made of four marvelous tubes built up like a spiral staircase. They carry food to the petals up from the root.

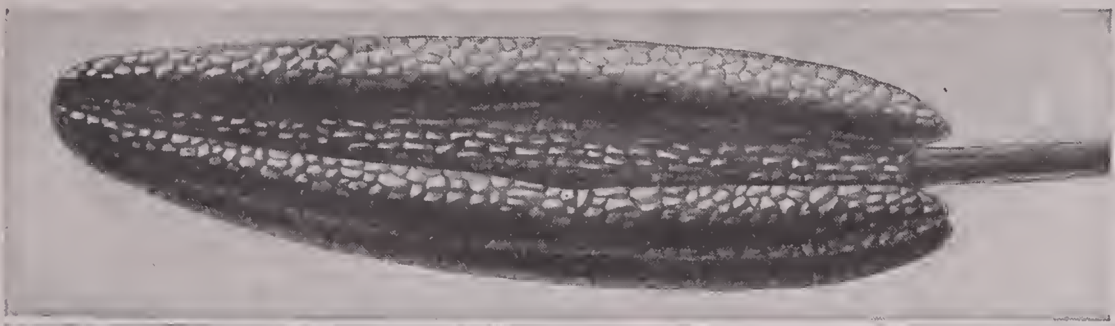


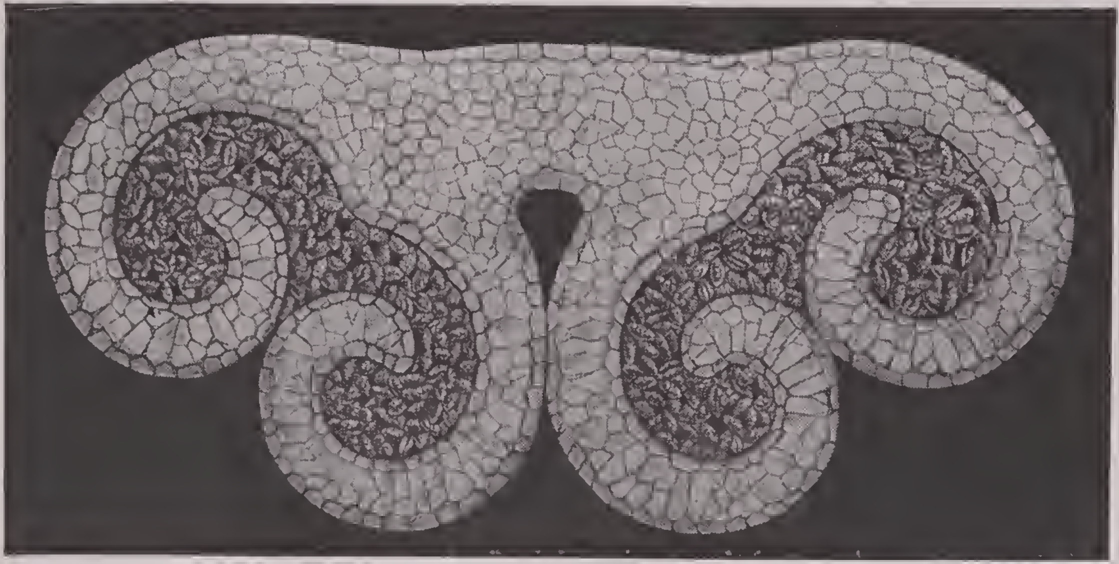
6. If we cut this slender petal in two and put the edge of it under a microscope, this is what we see in this thin edge like paper. The black patches scattered along the strip are the delicate veins.

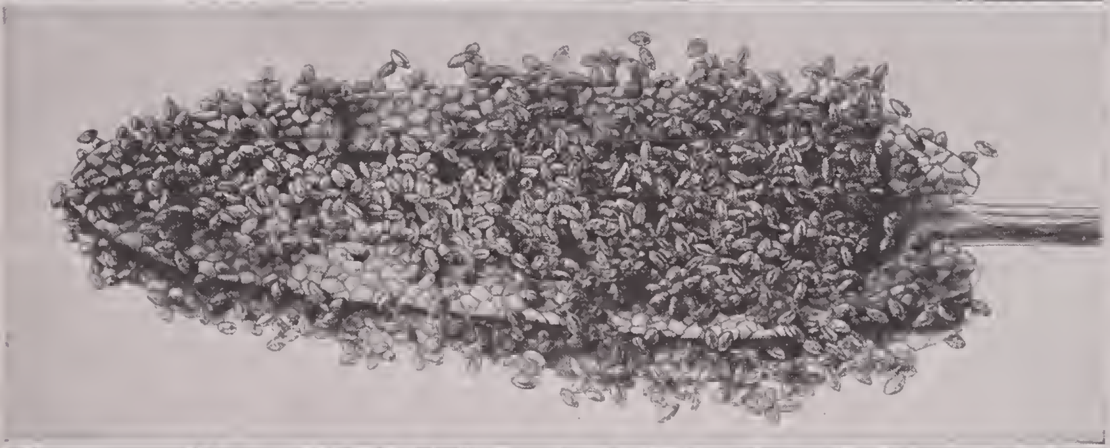


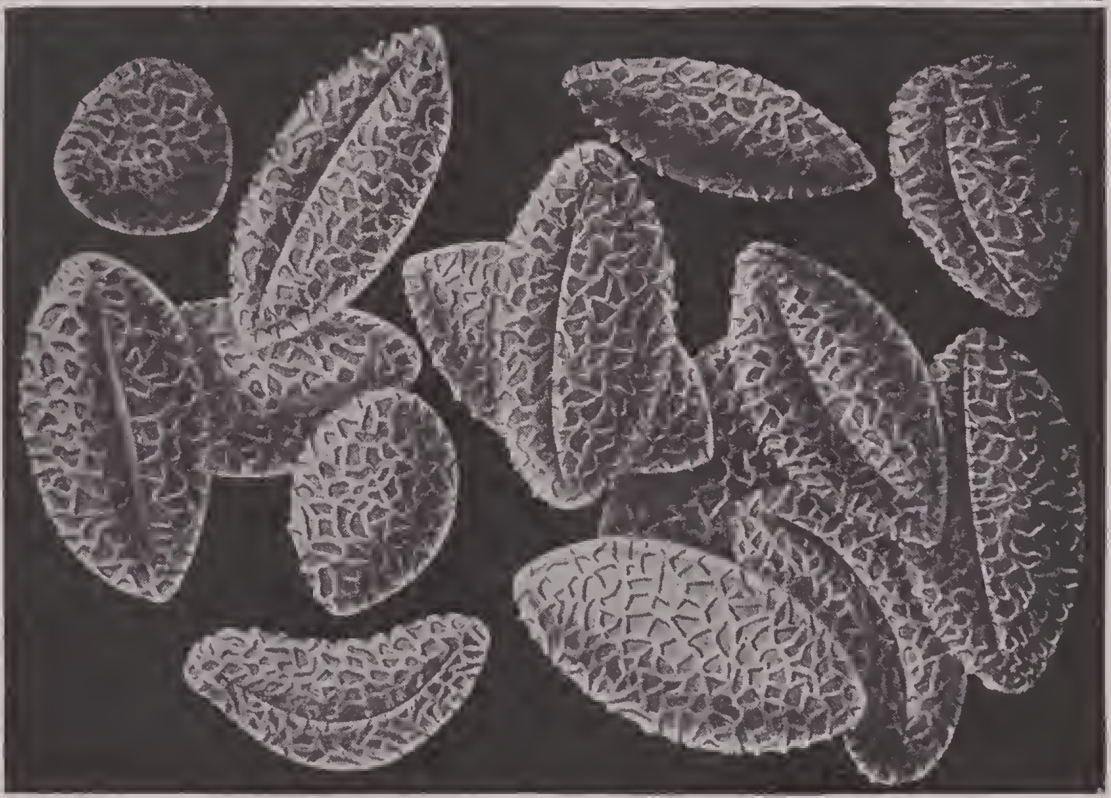
7. Now look closely at the six anthers, six little factories we may call them, clustered round the style that swells above them till the three-fold stigma bursts out at the top. Take your watch out of your pocket and think. Look at the works inside, and then say to yourself, "The works inside these anthers are more wonderful still."

8. Inside these anthers are made the little grains of pollen we see lying in the anther here—the yellow powder that sticks to your finger if you touch it. We may think it is nothing, but is there anything in the world more wonderful? A speck of dust, a great man says, has power enough within it to break a continent in two, and this speck of pollen has the power to feed, to work, and to build up Life itself.







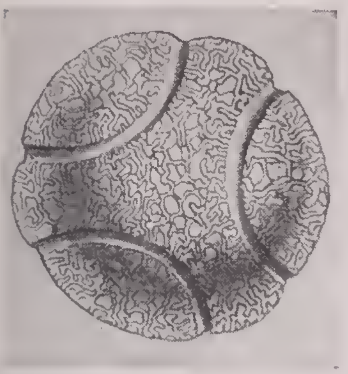


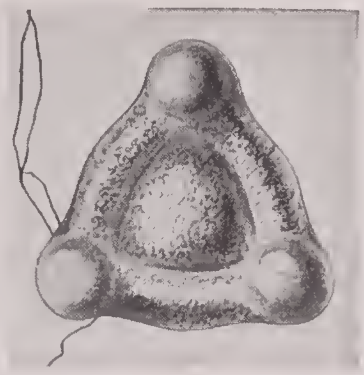
9. Let us look at the anthers under a microscope, while the walls of this workshop stand secure. For they are about to fall, pushed outward by the growing strength within them. Notice what a delicate structure it has.

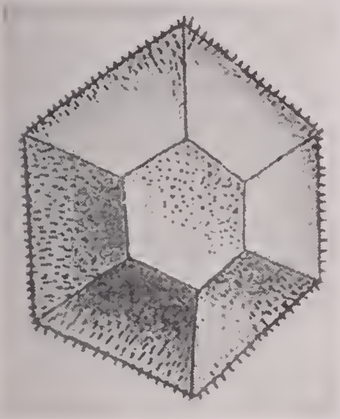
10. Sheltered from all harm are the wonderful grains, seen clearly in this cut across the anther, growing in power and building up the force that is soon to make itself known to us. Owing to the risk pollen grains run of being lost in their business of getting from one flower to another, Mother Nature sees to it that a great many more pollen grains are produced than are really needed.

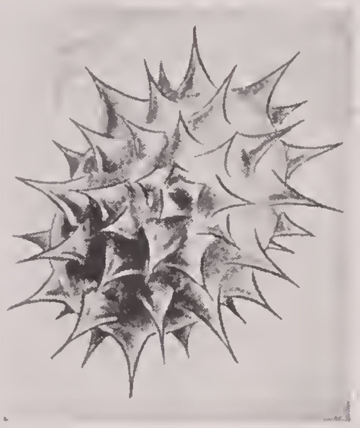
11. Now the grains have burst their bonds, and the anther is yellow with pollen. Like a magician's wand it is, for a touch of this pollen brings a new flower into the world. All that's needed is a breath of wind or the passage of a traveling insect to transport the golden dust, and the miracle is accomplished.

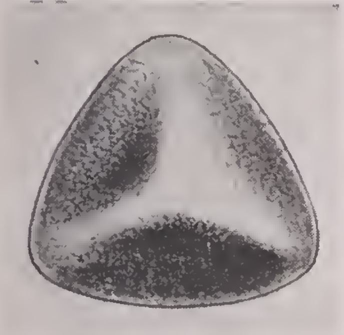
12. We see the pollen grains closely here, greatly magnified. Marvelously are they made, with rough coats by which they will cling to the hairy body of the bee when it comes. Another thing that enables the pollen grains to fly with the wings of friendly insects is that in many cases they have a sticky substance over their whole surface, and this and their variously shaped grooves make them cling together, so that insects carry away large masses of the grains in going from flower to flower. This tends to make the process of fertilization more certain.

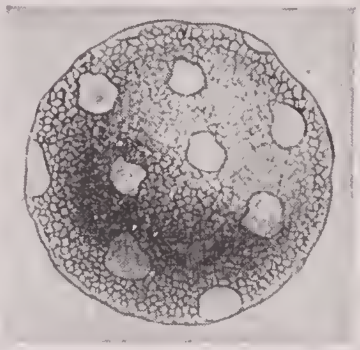

Passion Flower

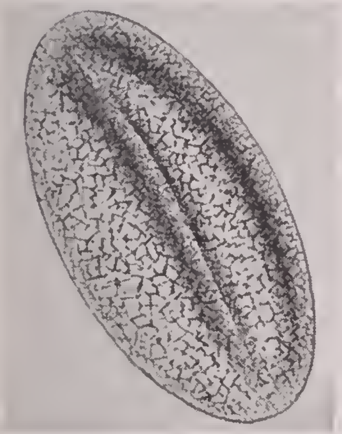

Willow-Herb

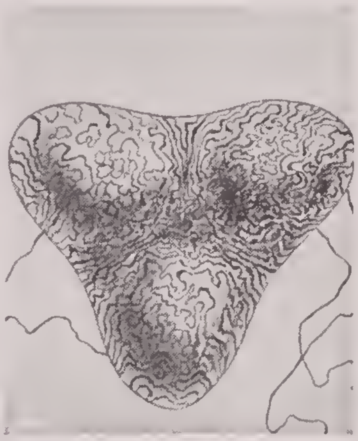

Dandelion


Marguerite

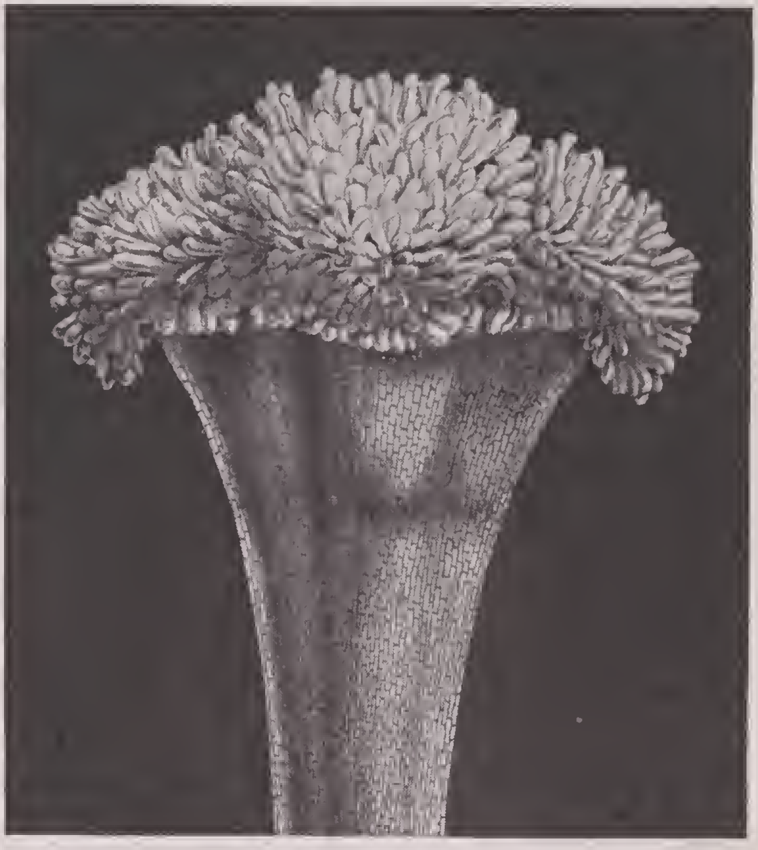

Nasturtium

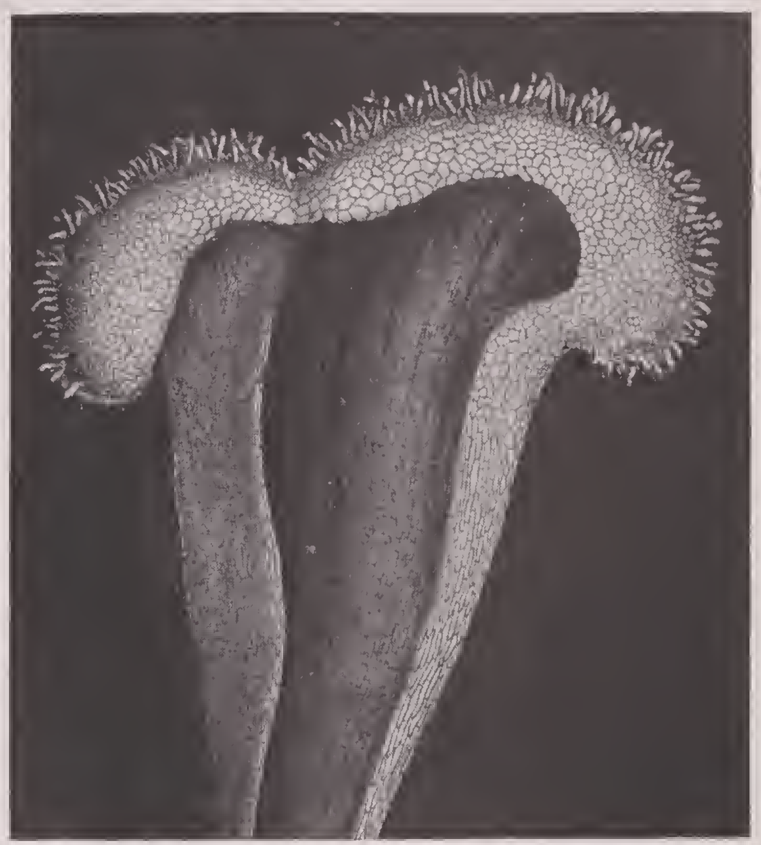

Phlox

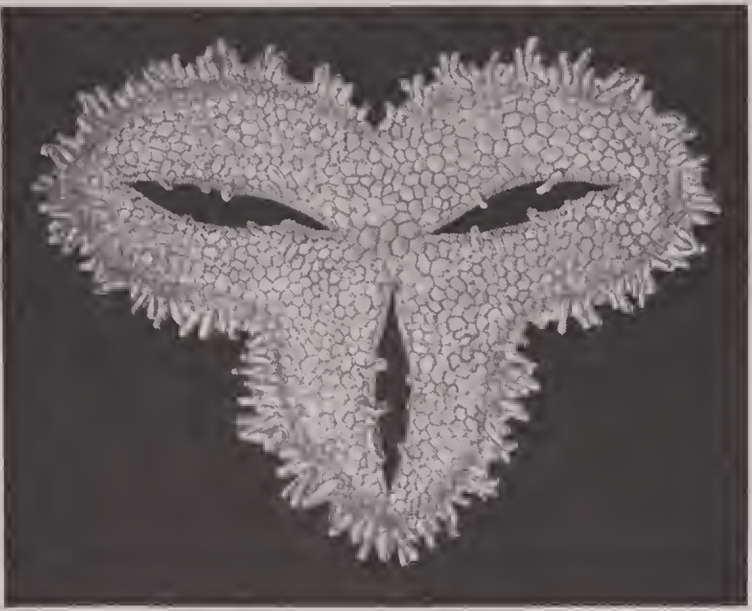

Tiger-Lily


Rhododendron

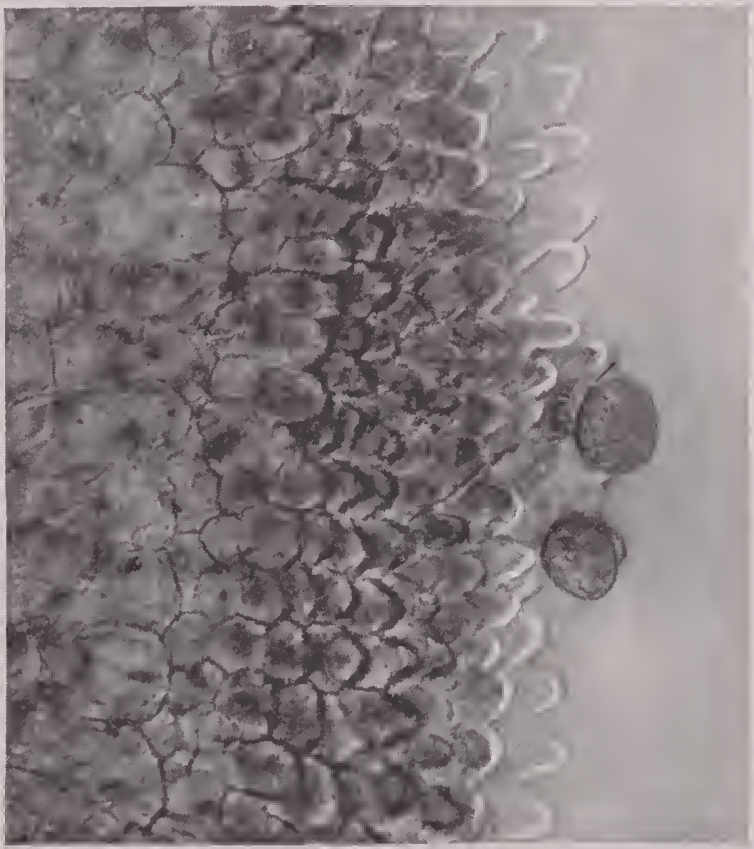
13. How immeasurable and unthinkable are the powers of Nature! No two flower-seeds are quite the same; neither are their pollen-grains. Nature has patterns enough and to spare, and she makes nothing, we must believe, without care and purpose. These few pollen-grains have been photographed under the microscope, and we see how beautifully they are made, though we cannot tell why this should be this and why that should be that. It is part of the great mystery that Life will one day reveal to its children.


14. Let us look now at the stigma, and look closely at the top of it. We see how easily a grain of pollen may lodge in this rough place held by these rough sticky points which the microscope so clearly shows. Here the grain lies and waits until the moment comes for the great work it is to do.


15. And now we cut right through the stigma downwards until it looks like this. We see its delicate structure, how beautifully it is made, but, more important still, we see a hollow passage down the style. It is an astonishing thing that travels down this passage to the home of life below.

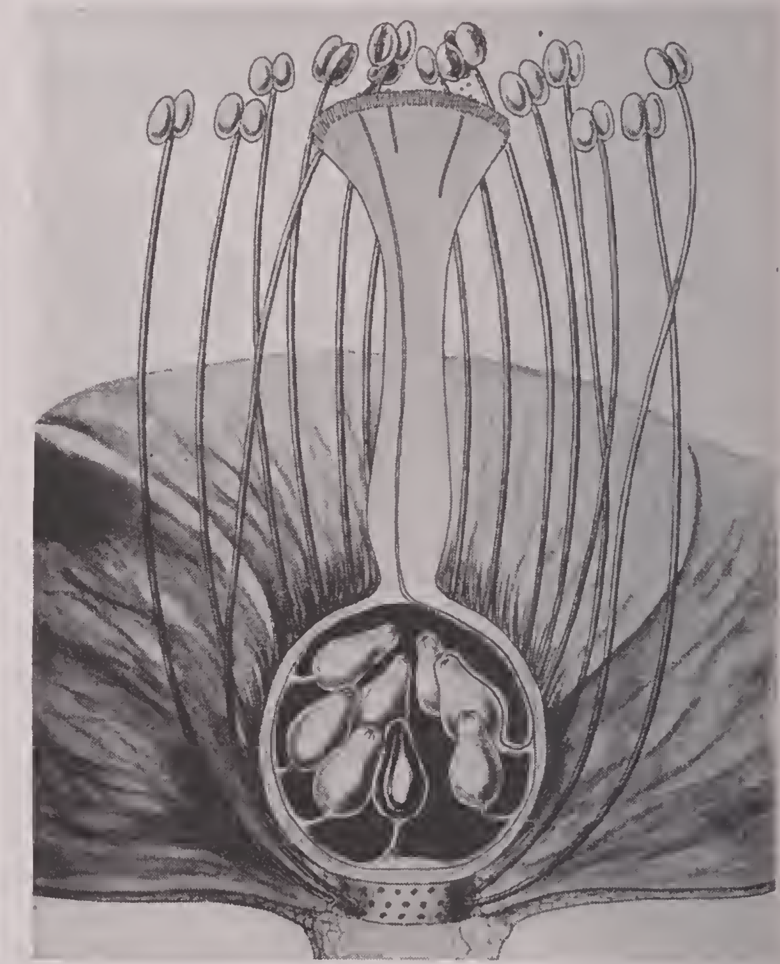


16. There are three of these narrow ways through which there comes to the heart of the flower the messenger of Life. Through each of the three heads of the stigma this hollow passage runs, until the three join in the style and run as one to the ovary below. Here we have cut a slice across the stigma showing the three ways leading to the ovary. These passageways, as we shall see, are the portals which lead to new flower lives. It is through them that the pollen tubes will travel on their errand of creation.



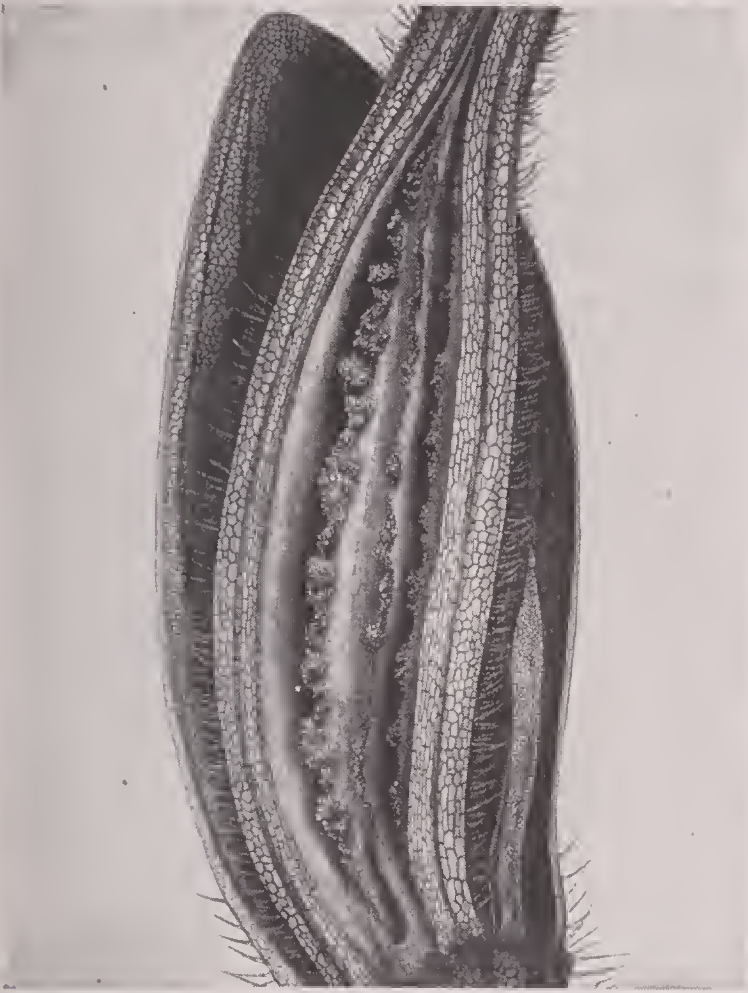
17. Now comes the bee this way, fresh from another flower, laden with its sweet and golden stores, and covered thick with pollen-dust. It must brush past the stigma on its way to the nectar, and it leaves on the stigma tiny grains of pollen from another flower. Here we see them as they lie on the surface of the stigma ready for the great work before them.

18. And now is the wonder of wonders. The pollen specks make their way down through the stigma till they reach the hollow space. They swell up and each one sends out a wonderful tube. It shoots out and passes down the narrow space until it has reached the ovary, the place where the seed of life is hidden.

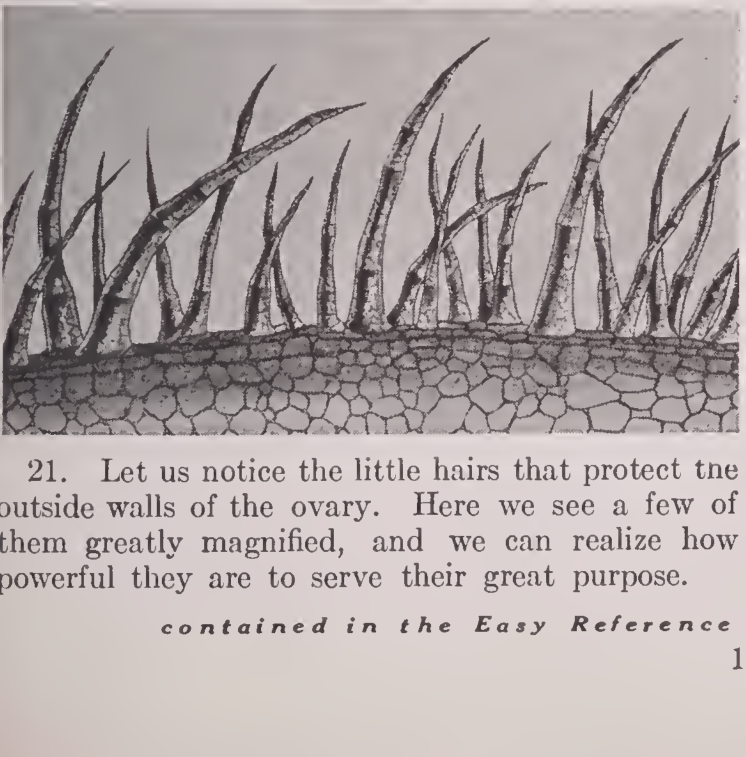


19. This is the place where a flower is born. In this sheltered chamber are colonies of little green things called ovules, clinging with tiny stems to the walls. They lie here waiting for the messenger who comes from the outside world. Soon the pollen-tube arrives, making its way through the wall of the ovary and pushing on until it touches a little green ovule. If the tube does not touch it the ovule must die, but at the touch of the pollen-tube it grows into life, becomes a seed, and will become a flower.

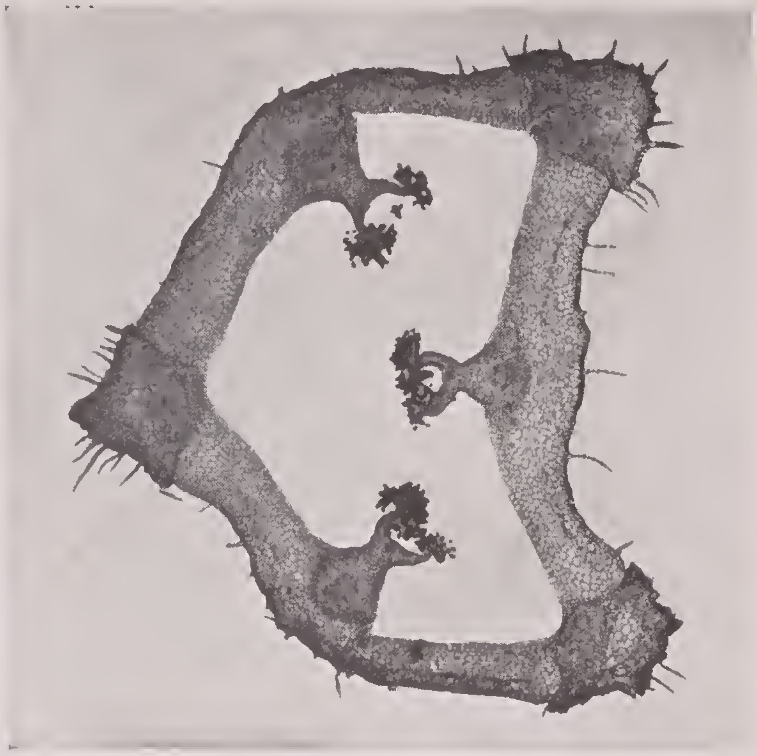
A new life has been born into the world; the wand of Nature's wizard has penetrated her hidden ways and wrought a miracle there, and we have passed by, perhaps unheeding and unthinking.



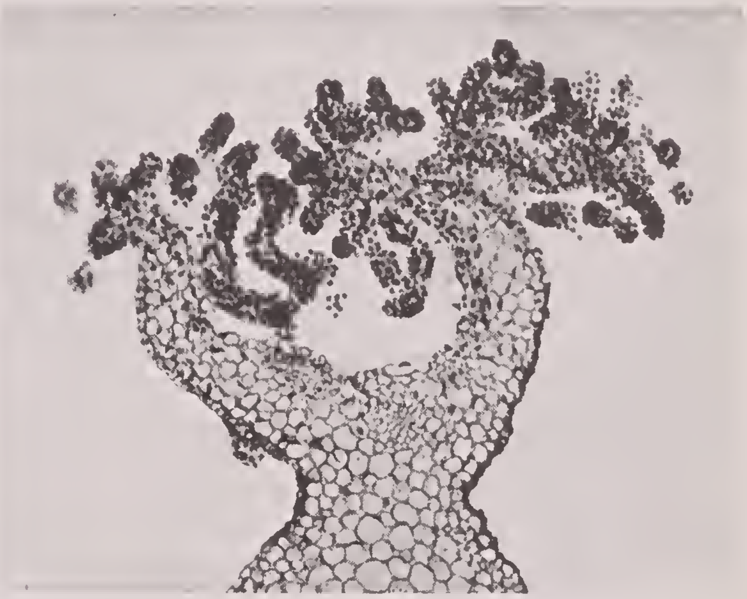
20. Now we will peep into the ovary itself, cutting through it downwards. It happens that we have taken the lady's slipper, a distant cousin of the lily, for this picture. The little white specks on the ridge in the heart of it are the ovules. Marvelously sheltered in this inner chamber where a flower is born, yet the gold dust the bee has brought from far away throws out its tubes and pushes down with its quickening touch until, from this hidden place, there comes out into the world the beginning of another flower.



21. Let us notice the little hairs that protect tne outside walls of the ovary. Here we see a few of them greatly magnified, and we can realize how powerful they are to serve their great purpose.



22. We have cut through the ovary downwards; now we see it cut across. The little ovules are clustered on the three little ridges.



23. Now we turn the microscope onto one of the three ridges and see the ovules nearer and nearer. Each little group of specks makes up an ovule.

24. It grows into a seed like this. Even here, in this highly magnified photograph of a seed, the eye sees almost nothing; yet this tiny thing, after the coming of a pollen-grain, has in it the power to reproduce the plant in which it grew. It is the cradle in which the beauty of the earth lies asleep.

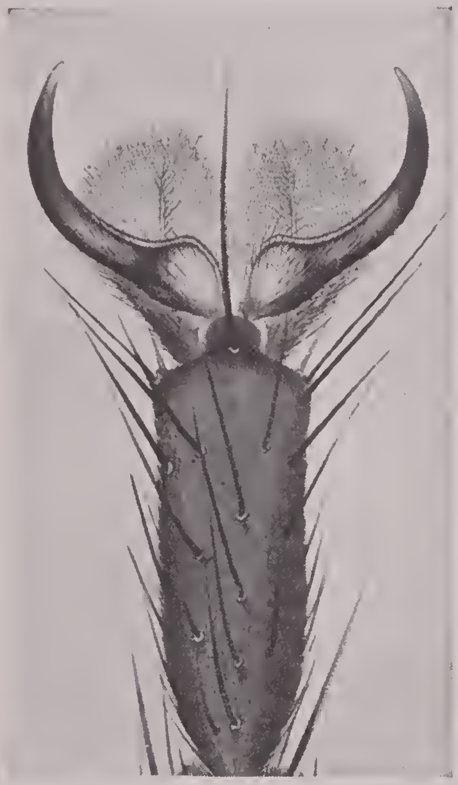
FLY. One of the deadliest of all creatures is the common buzzing housefly, found wherever mankind dwells. It is no exaggeration to say that during the Spanish-American War flies, as carriers of typhoid and other diseases, caused the death of more American soldiers than did all the bullets of the Spaniards.

A DEADLY ENEMY OF MANKIND

This Housefly has been considerably enlarged in the picture. But if we showed him as big as an elephant, it would not be out of proportion to the harm he does in the world.

Catch a fly and look at it through a magnifying glass. You will see that its claws and padded feet are covered with bristling hairs, that the body is a mass of hairs, that the greedy tongue is spread over with sticky glue. If you could look through a powerful microscope, you would probably find that on those hairs and mixed up with that glue are deadly bacteria—perhaps germs of typhoid fever, tuberculosis, dysentery, and a score of other diseases; for this "harmless insect" has probably just visited some infected refuse pile.

A GERM CARRIER

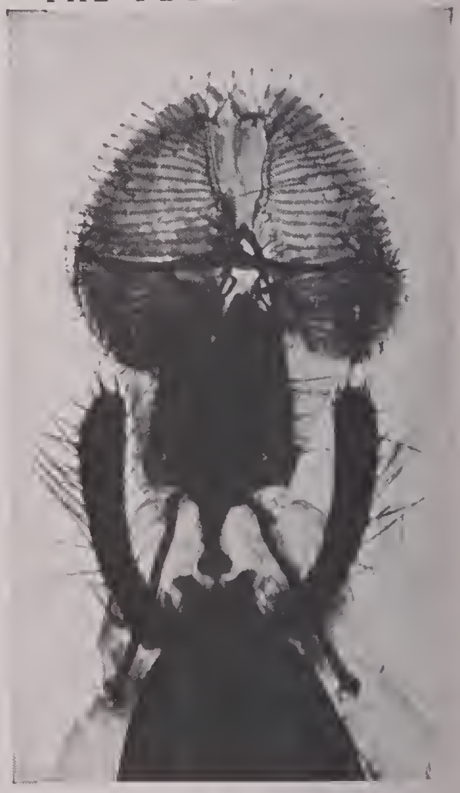


A fly's foot looks like this under the microscope. Those two horns are claws, and those two pads beneath them enable the fly to cling to a window pane or walk upside down on the ceiling. On these pads disease germs frequently are collected, which are transferred to your food when the fly walks over it.

"Fly-swatting," except in early spring before the breeding season has begun, is almost useless. The number of flies is not so much regulated by the number of grown specimens that escape the "fly swatter" as by the number of suitable spots the female fly can find in which to lay her eggs. And while she would rather lay them in horse manure than anywhere else, if necessary she will use a garbage can, a drain, or any other place where filth accumulates, usually not more than 200 to 300 yards from the place where she spends her life. So, if you would put down flies, don't let them breed. If people would not allow filth to gather there would be no flies.

Let us trace the short life of a housefly and then we shall best know how to get rid of them. Each year a certain number of flies and their larvae live over through the winter. As soon as the warm weather appears, the female, who has been hanging behind a picture molding or a bit of torn wall-paper, comes out and looks for a place to lay her eggs where moisture and filth exist together. Inside of one day, the first batch of about 150 eggs has hatched into small white larvae or maggots. After about five days each maggot goes into the pupa stage, in which the baby fly is wrapped in a tough protecting shell. About five days later a full-grown fly emerges from each chrysalis. Since the maggots, which develop in only a few days, can travel considerable distances, the only way to check fly-breeding is to remove garbage and manure twice a week, if these articles are not screened or treated with chemicals to destroy the eggs.

THE FLY'S TONGUE

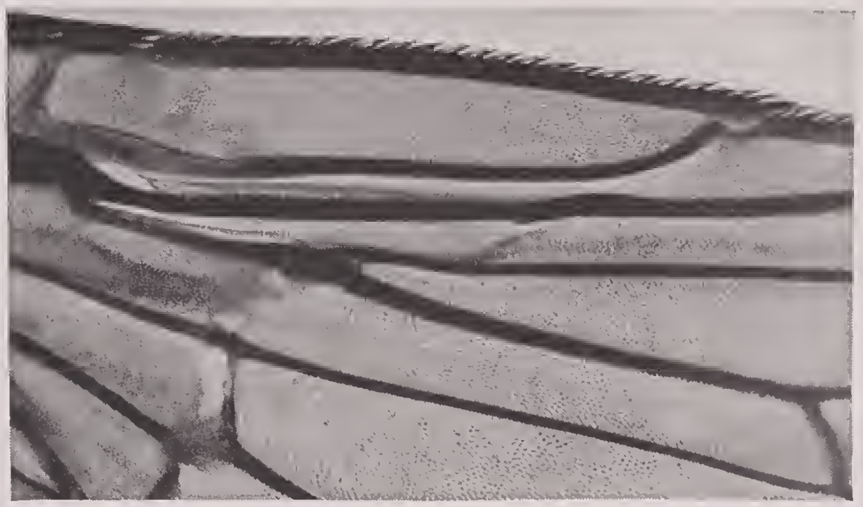


With this tongue of his the fly dabs at our food. It is here shown flattened out for examination under the microscope. It is made up of very tiny tubes opening into two larger tubes which connect with the mouth.

It has been computed that between April and September one wintered-over female fly might theoretically have 5,598,720,000,000 descendants, if all her female offspring live and start laying eggs in proper time. Of course they don't all live and lay eggs, but enough of them get through to help make the human death rate from typhoid about five times as great during the summer fly-season as it is during the winter months, when the flies are not active.

Killing one fly in April, therefore, amounts to killing millions of flies in August. If the successive generations of females should find no places to breed, it is easy to see that flies will simply cease to exist; and when flies cease to exist typhoid fever, dysentery, and certain other diseases which particularly attack young babies will be greatly lessened.

A FLY'S WING UNDER THE MICROSCOPE

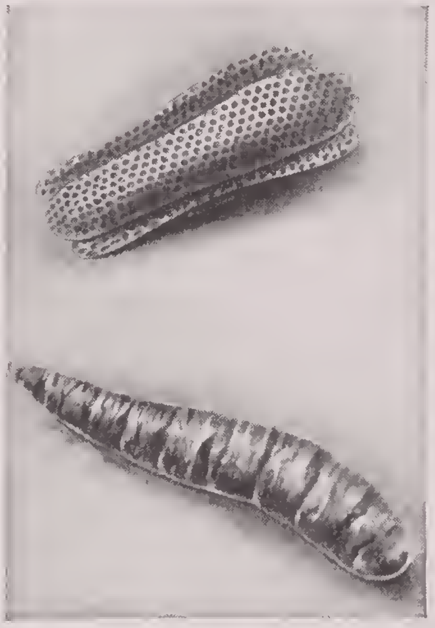


Beautiful gauzy thing, isn't it, this fly's wing? And he's a wonderful flyer too, the fly. When he flits about so airily and lightly, those wings move at the rate of 330 beats per second, according to the estimate of scientists. They are moved by powerful muscles and supported and strengthened by those veins or ribs called "nervures."

Besides the housefly there are many other members of the fly order, very different from this unwelcome guest of our households. The mosquitoes, for instance, are among the other obnoxious and dangerous members of the group (*see* Mosquito). So are the flesh flies, which lay their eggs in stored meats; botflies or heel-flies, which torment and kill cattle, sheep, and horses; and gall gnats, which damage crops.

There are some kinds of flies, though, that are the good friends of man instead of his enemies. Some of these destroy harmful species, and so help to keep their numbers down. The larvae of others feed upon decaying matter and thus help to clean up disease-breeding materials.

EGG AND LARVA



The lower picture shows the larva of a Housefly, which inside of 10 days will become a flying insect. Its mouth is at the pointed end. The upper picture shows the greatly magnified egg of another species of fly, remarkable for the delicate "honeycomb" pattern.

Among the other members of the fly order are the tiny midges and the fungus gnats; the blood-sucking black flies, those terrible pests of the northern woods, fierce biters that have been known to kill men and animals; the horse-flies, which frequently bite persons in wet bathing suits; the bee-flies, which mimic the appearance of bees and feed on the nectar of flowers; the syrphus flies, which resemble bumblebees and wasps, and destroy great numbers of plant lice; the drone flies, whose larvae live in foul water, where they eat up decomposing vegetable matter; the robber flies, which swoop down on other insects with murderous greed; the bee lice, bat ticks, and sheep ticks, which live upon the bee, the bat, and the sheep as parasites, and which have no wings, but belong to the fly family just the same.

Less interesting members of the group are the louse flies, the nimble flies, the flesh flies, the thick-headed flies, the hump-backed flies, the flat-footed flies, the big-eyed flies, the March flies, the false crane-flies, and many others. It has been estimated that there are about 350,000 species of flies in the world. Flies are among the oldest of insects. Their fossil remains are found in rocks of early geologic ages, and also preserved in amber. (*See* Amber.)

Flies constitute the order of *Diptera*, which comes from the Greek words meaning "two wings"; scientific name of housefly, *Musca domestica*.

FLYCATCHERS. Sticky fly-paper gets the fly indoors; the flycatcher family of birds get it out-of-doors—and besides they take countless other harmful insects, such as grasshoppers, weevils, moths, and caterpillars. To aid these birds in catching their prey, which they often take on the wing, they are furnished with a gristly hairlike growth at the base of the bill, in some species as long as the bill itself.

Flycatchers of the Old World belong to the family *Muscicapidae*. They are small active birds, in the hotter latitudes very numerous and showy, with crests and long tail feathers. Such are the Japanese species, commonly pictured on screens and fans. These birds live in the woods and are usually songless and solitary.

The American flycatchers belong to the family *Tyrannidae*. There are about 400 species, of which only about 30 are found in the United States. They are mostly small dull-colored birds, but many have a touch of bright color about the head. These birds inhabit the open country, frequenting orchards and gardens. Some species nest in the crannies of buildings. Many kinds show a liking for water, and in dry climates every roadside watertrough has its attendant flycatcher. Most members of the family are songless, but many have very musical calls.

One of the most remarkable of the species is the *scissor-tailed*, of the southwest. It is a tiny black and gray bird with pink trimmings. Its deeply forked tail is sometimes 10 inches long; when excited it has a scissor-like way of opening and closing this appendage.

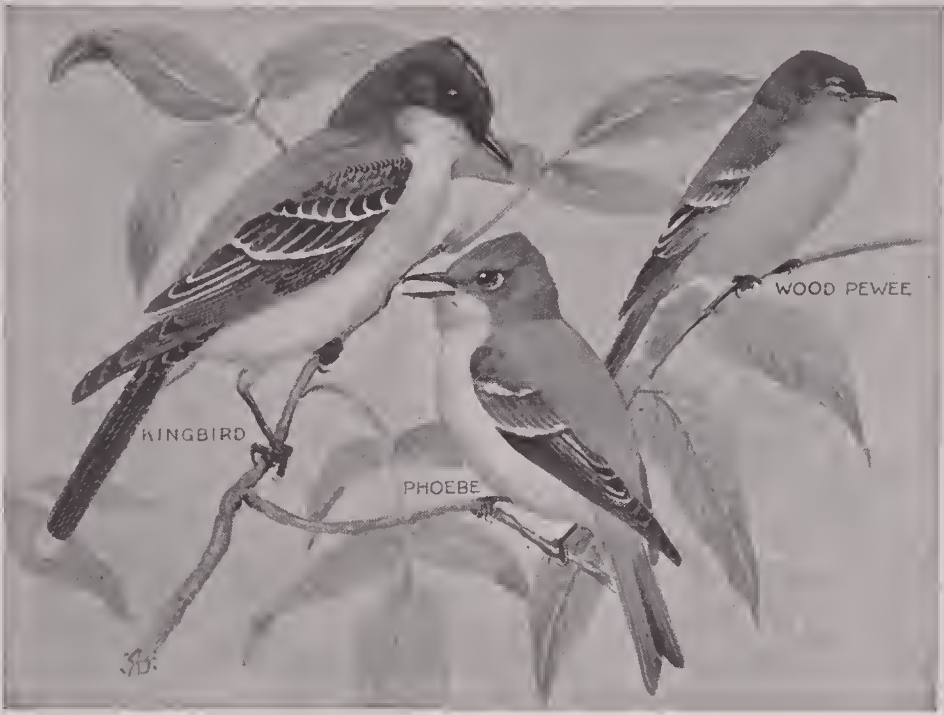
Besides the birds called by the family name, this group includes also the kingbirds (for illustration in color, *see* Birds), and the pewees, of which the wood pewee and the phoebe are well-known representatives. The kingbird is a courageous and aggressive little fighter, often routing crows and hawks by the fury of its attack. It is about eight inches long, with a black glossy crown, slate-colored back and wings, and a black tail tipped with white. It is usually found perching on dead limbs and fenceposts and other good points of observation, whence it makes sudden dashes after passing insects.

The wood pewee is a shy forest bird, ranging through eastern North America from Florida to Canada. It is about six and one-half inches long, of dark olive green above and yellowish-white below. Its plaintive little note *pee-a-wee, pee-a-wee* is most distinctive.

The phoebe, a bit larger than the wood pewee, is of the same general color, but of less shy habit and nests in buildings, seeming to prefer human neighbors. Its call very closely resembles its name.

Scientific name of kingbird, *Tyrannus tyrannus;* wood pewee, *Myiochanes virens;* phoebe, *Sayornis phoebe.*

THREE MEMBERS OF THE FLYCATCHER FAMILY



These bright little birds are all inhabitants of the United States. They look self-confident and plucky, don't they? Just imagine that Kingbird driving off a big Hawk! The Phoebe is a friendly bird, nesting by choice in buildings, but the Pewee is more shy, preferring the forest.

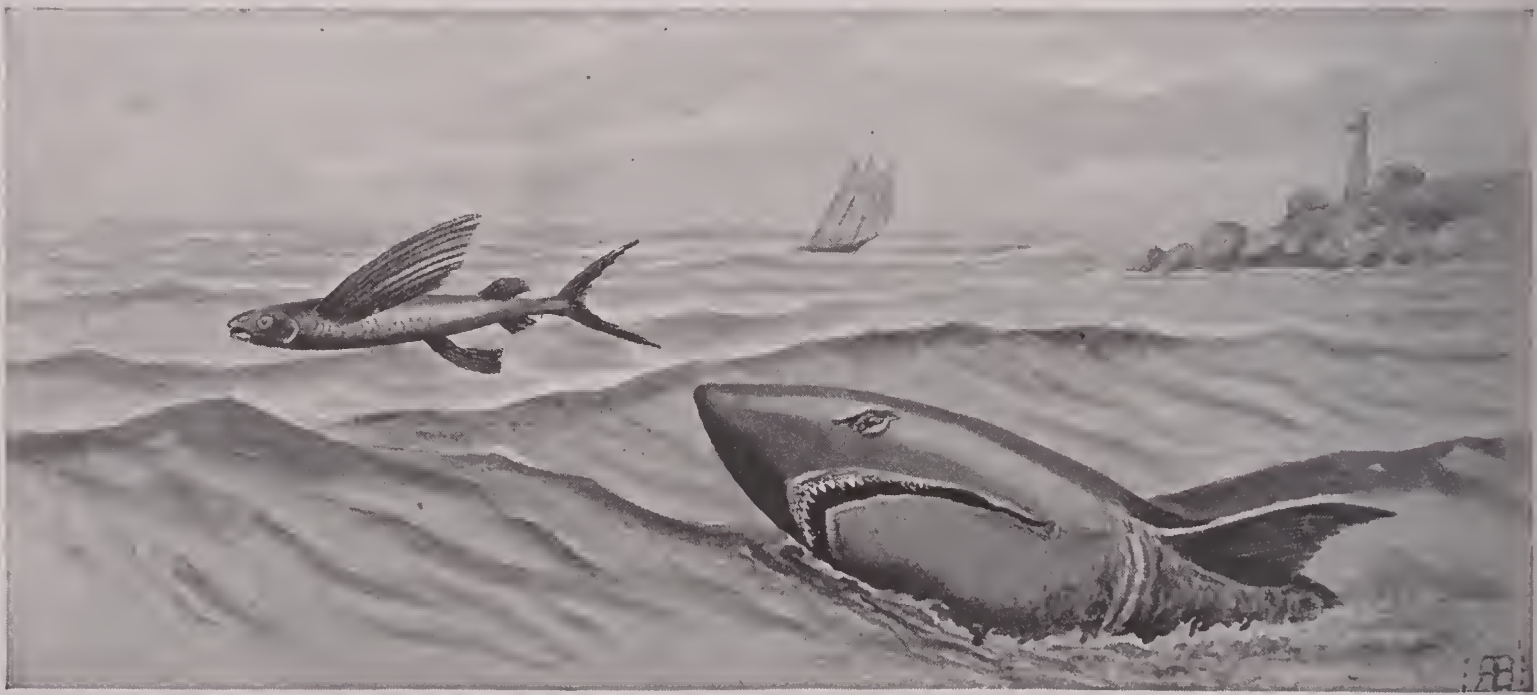
FLYING-FISH. A "fish out of water" is not always the helpless flopping creature which has given us this common expression for the awkward bungler. Indeed, few things are more beautiful than the sight, so frequent in warm seas, of a company of silvery fish rising suddenly out of the waves under the steamer's bow and darting through the air like huge dragon-flies.

Flying-fish, of which there are about 65 species, are still somewhat of a puzzle. Even scientists are unable to agree as to their method of flight, some asserting that the fish propel themselves by their big front fins; others saying that these fins act only as flying planes and that it is the speed with which the fish shoot out of the water that carries them along. The smaller flying-fish of the Atlantic Ocean cover short distances only out of water, but the larger species, found off California, often travel 200 yards. Their fins are eight or nine inches long.

All flying-fish use their power of flight to escape from their numerous enemies, chief of which are sharks and the tuna fish. They sometimes fall on the decks of ships in their frantic efforts to outdistance their pursuers. Most varieties are excellent food.

Scientific name of common flying-fish, *Exocoetus volitans;* of California flying-fish, *Cypsilurus californicus.*

THE SHARK AND THE FLYING-FISH



One of the favorite sporting events off the coast of California is a 200-yard dash, like that shown in the picture, between a shark and a flying-fish; but it's anything but sport for the pretty little fish with the winglike fins. Let us hope this picture shows the beginning and not the end of the race. One might assume from that despairing look in the shark's face that he had lost. But it really means nothing; his mouth is built that way.

FOCH (*fôsh*), MARSHAL FERDINAND (1851–). "Outflanked on the right, outflanked on the left. Situation on the whole excellent. Am going to advance." This was General Foch's brief message to General Joffre, at the critical battle of the Marne early in September 1914. And advance he did, a fact that in large part accounted for the glorious French victory and for the saving of Paris from German occupation. Upon this occasion and throughout the more than four years of hard-fought battles that followed, Foch's unchanging confidence, and his ability to inspire his men with the same deep conviction of victory, was one of the chief causes for his rapid promotion and the ultimate triumph of the Allied cause.

Like his predecessor Joffre, General Foch was a son of the south of France. For years he had been professor of military strategy, and later director of the War College of France, and his books on the art of war had become famous throughout Europe. He believed firmly that the only way to win battles was sooner or later to take the initiative and advance against the enemy. "To make war," said he, "is to attack." But this did not prevent him in practice from being extremely careful not to be led into rash advances.

After the Allies had made a tremendous but unsuccessful attempt to drive the Germans out of France, in May 1917, Foch was made Chief of Staff of the French Army. At this time the hopes of the Allies were low. They were even lower in March 1918, when the Germans began their big advance in the West. Indeed it looked for a time as if they might go right through Amiens to the English Channel. But the spirit of Foch prevailed. He simply refused to admit that he was beaten. "Before Amiens, in Amiens, and behind Amiens, I will go on fighting," he declared. On March 26, Foch was made Commander-in-Chief of the entire Allied army, and presently the advance of the victorious Germans was stopped.

Then, on July 18, Foch began the great Allied offensive, which never ceased until complete victory was won. "We have begun and we shall continue," he declared. First at one place, and then another, the French, British, and American armies under his direction hurled the enemy back until they were driven out of France. Then came the armistice of Nov. 11, 1918. On the following day Foch addressed his victorious troops as follows: "You have won the greatest battle in history, and saved the most sacred cause—the liberty of the world. Well may you be proud. With immortal glory you have adorned your banners. Posterity cherishes for you its gratitude."

On Aug. 16, 1918, he was made Marshal of France, the highest honor the French republic could bestow.

THE WAR HERO OF FRANCE

This is General Foch, carrying his famous black portfolio, containing some of the reports and plans which helped bring about the greatest victory in history.

FOG. One of the most frequent experiences which one has in crossing the ocean in winter months is to pass through a fog. The great whistle of the steamer blows at regular intervals, sending out a hoarse warning note that has a tendency to make travelers thoughtful. They know that about them on the sea are other boats, large and small, great liners and fishing boats, which are invisible through the thick veil of fog and may smash into one another. Off the Newfoundland Banks many a small fishing boat has been run down by an ocean liner during the heavy fogs that prevail there. The larger boats themselves have at times collided in the gloom or have struck icebergs, like the ill-fated Titanic, which sank in 1912 with a loss of 1,517 lives.

Dew and fog are much alike. Dew is moisture which forms on vegetation, while fog forms in the air on particles of dust. "But," you may say, "there is no dust in ocean air; it is clean." Even clean air, however, has some dust in it, and on these tiny dust particles the moisture condenses whenever the temperature is lowered.

There are several ways in which the temperature of a layer of air is lowered. Warm moist air blowing over a cold surface is cooled and must squeeze out some of its water vapor. The fogs off the coast of Newfoundland are due to the fact that the air from warmer parts of the ocean blows over the icy Labrador Current, becomes chilled, and so condenses its moisture. Fogs form in the valleys through the lowering of the temperature of a body of air. Wind or rising temperature dispels fogs. It is for this reason that fogs usually disappear as the day advances.

The most remarkable fogs are those that form over great cities such as London. At times the fog is so dense that traffic is suspended and people travel about with lanterns. The reasons for London's fogs are not hard to find. The prevailing winds are moisture laden since they blow in from the Atlantic. In winter they meet cooler currents over the land, and mingle with the great amount of dust and smoke floating about over the great city. Fog forms more easily there than in cleaner air and once formed is less apt to clear off. The fog particles become coated with an oily substance and therefore evaporate less readily than over the ocean. The more manufacturing that is done in a city, the thicker and more frequent its fogs become.

The invention of wireless telegraphy has done much to lessen the dangers of collision in a fog at sea. Another safety device is the submarine signal system based on the fact that sound travels much farther through the water than through the air. By this system, vessels equipped with microphones (instruments like very delicate telephone receivers) can detect from afar the throb of a propeller, or the ringing of special underwater bells.

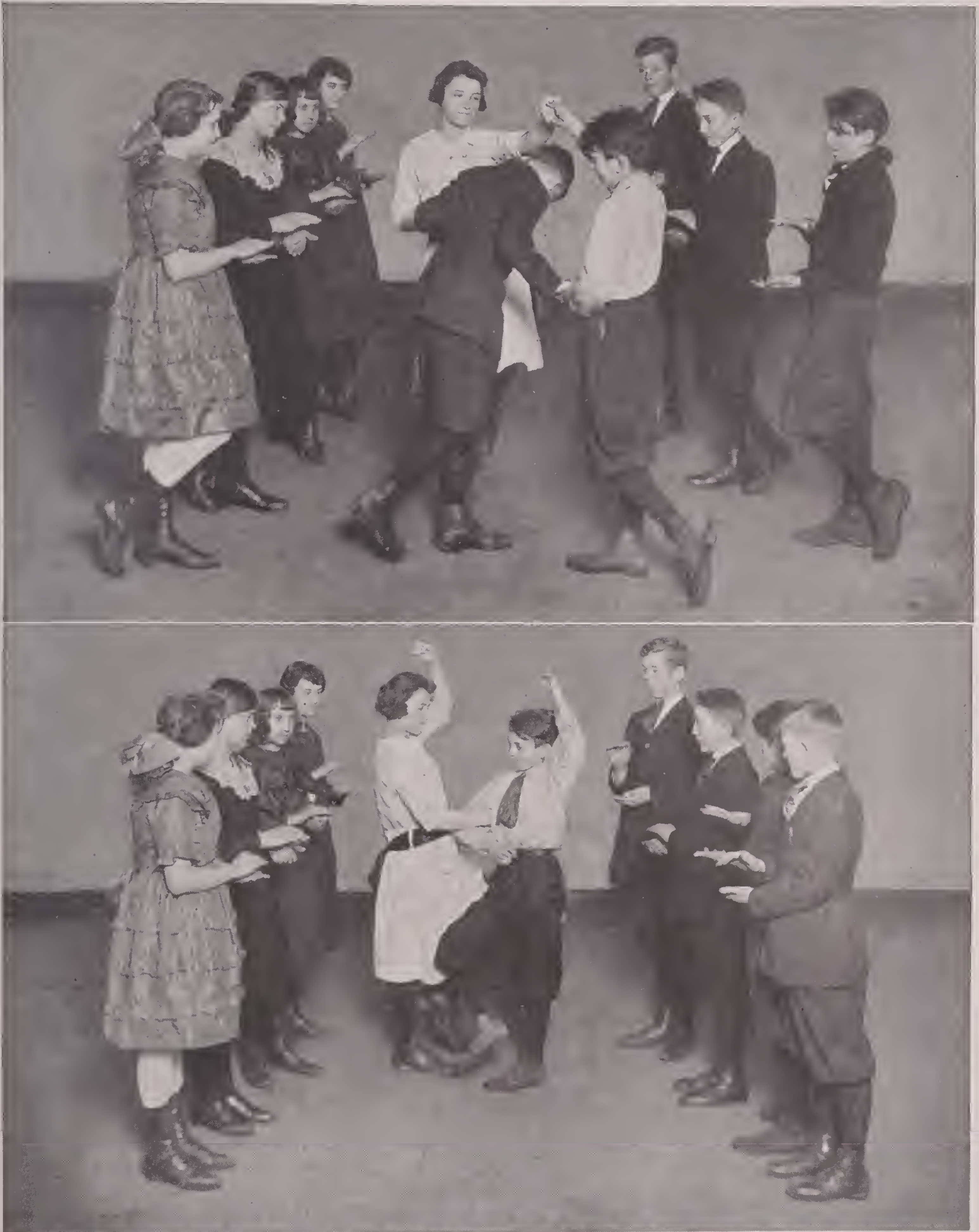
FOLK-LORE. Folk-tales, folk-songs, and folk-dances are the Topsies of the literary and musical world. They have no father and mother, but like Topsy they "jes' growed."

In the days of long ago, when the day's work was done, the older folk would tell the younger generations the weird tales of gods and men, of ghosts and fairies and animals, which they themselves had heard their fathers tell. They sang the stirring songs of battle and mournful ballads which had been handed down from a past so remote that no one can guess when it began; and mothers crooned their babies to sleep with lullabies almost as old as the human race. When the harvest had been gathered in, or when the magic fingers of spring were awakening the flowers from their winter sleep, or at other times of festival and ceremonial observance, groups of young men and maidens

ONE OF THE FOLK-DANCES THE LITTLE PEOPLE LIKE SO WELL

The merry old dances our forefathers used to do centuries ago in the Old World have recently been revived in the United States and are taught in many of the public schools as a part of the gymnastic work. Here is a movement from the dance-game of "Mary and the Lamb," which is a great favorite in the lower grades.

THIS IS HOW THEY "POP THE WEASEL"



In the dance "Pop Goes the Weasel" two rows of five face each other and there are four movements. When the game begins, the first couple goes skipping down the outside behind the lines, eight counts and then back again eight counts. Next, the first couple swing the girl of the second couple and "pop" her under their arms into her place, and then repeat the operation with the boy of the second couple, as shown in the upper picture. At the end of the fourth movement, the first couple link right arms, and with left hands above their heads skip once around to their places, as shown in the lower picture.

danced the strange old dances that others before them had danced for untold centuries. Even today, all over the world, these ancient tales and songs and dances still live. The peasants of England still dance about the Maypole, the Hopi Indians of New Mexico still have their terrifying snake dance, and American fathers and mothers tell their children the story of 'Little Red Riding-Hood' and sing them to sleep with 'Bye, Baby Bunting.'

THE FAMOUS SWEDISH "KLAPPDANS"

Here are the little folks dancing the Swedish Klappdans, which begins with the children standing in a double circle. At the third movement, which is shown in the illustration, they dance the heel-and-toe polka, bending backward on the heels and forward on the toes.

Folk-Lore in the Life Story of the Race

Little did the unschooled people of early days think that scholars would one day search out and study their simple lore. But that is being done today by students and societies in many lands. The old superstitions and beliefs in fairies, in ghosts and goblins, in witchcraft and magic; the customs and ceremonies celebrating birth, marriage, and death; the old songs, dances, and games, ballads and tales, riddles and proverbs handed down from the past—all these help us to understand what our ancestors were like, and thus many hidden pages are revealed in the story of man's progress.

The first to make a serious study of folk-lore were the brothers Wilhelm and Jacob Grimm, two gentle German scholars who lived about 100 years ago. Their names are as familiar now to children as to men of learning, for among the tales which they collected from the peasants of Germany are the stories of 'Lucky Hans', 'Hänsel and Gretel', 'Princess Snow-White', and many other favorites with children of today. In a similar way we received from France the stories of 'Puss in Boots', 'Little Red Riding-Hood', and 'Cinderella'; from England the 'Mother Goose Rhymes'; from the American negro the stories of 'Bre'r Rabbit and Bre'r Fox', and from many other lands and peoples tales which now belong to the children of all the world.

So too men have searched out and written down the old songs of all nations—the songs of seed-time and harvests, of winter and summer, crooning nursery songs, love songs, marriage songs, funeral songs, war songs. Nothing tells us more surely the sort of life a people lived than their songs. Take the beautiful folk-songs of Russia, for example. In their sad minor melodies and strange wild rhythms, even without the words, they give us a picture of a life so grim and sad that its only relief was in boisterous gaiety that still felt the touch of hopelessness. The folk-songs of Switzerland tell us of mountains and valleys; in their melodies we hear the shepherds' pipes and the "yodel" of the Alpine dwellers. The songs of Scandinavia suggest something of the surging of the ocean in their steady rhythm, and through them creeps the plaintive murmur of the waves. The folk-songs of the British Isles reflect the different characteristics of the different people living there together. Thus the Scotch 'Laird o' Cockpen' is as surely Scotch as the 'Minstrel Boy' is Irish, and one would no more mistake one for the other than he would mistake the tones of the bagpipe for the notes of the Irish harp.

'On the Bridge of Avignon'

Have you heard the old French song, 'On the Bridge of Avignon'? This was sung by the girls and boys of France more than 400 years ago. It tells how the people of all classes passed over the same bridge in the same way—lords and ladies, clerks and soldiers, pipers and street gamins. So it gives us a picture of France in those early days. We get a picture of an old time English politician, turning with every change of rule, in the English folk-song, 'The Vicar of Bray'; while the song 'Jenny Jones' gives us a good description of customs and costumes in early England—with its washing and folding and starching and ironing, and its sickness and death portrayed in the stanza:

> Jenny is dead, dead, dead,
> Jenny is dead, you can't see her now.

Folk-songs are the natural unstudied expression of the common people; they are the laughter and the tears of those who, hundreds of years ago, lived and loved as we do now. The songs of the common people were not made by rule. They sang as the lark or nightingale sings, and their art was so spontaneous that it still gives us pleasure much as when we hear a wild bird sing.

Folk-dances are the twins of folk-songs. Where you find one you find both, and often they even claim the same tune. Many folk-dances tell stories quite as the songs do. Did you ever play the Swedish weaving dance? Does it not tell you the story of the primitive flax harvest and the making of the linen? The rows of dancers advance and retreat, advance and retreat, in imitation of the beating used to separate the flax fiber from the straw. They whirl and skip and clap and we get a glimpse of the old-time spinning; and then the couples go back and forth in the shuttle movement of the weaving, and dance through the difficult over-and-under of the bobbin movement. Then comes the rolling of the finished cloth into the bolt, and the happy workers skip to their homes.

In the shoemakers' dance you all know the—

Over, over, over,
    Back, back, back,
Sist! sist!
    Rap, rap, rap.

Equally familiar is the sailors' hornpipe, with its hauling the anchor, hoisting sail, paying the slack, and wild heel-and-toe at the sight of land, which is the favorite of all gymnasium classes.

Nearly every nation has its own distinctive dances, such as the picturesque Scottish reel, the jolly Irish jig, the furious Italian tarantella, the stately Spanish saraband, and the live Polish mazurka. We in America have no folk-dances of our own, but because we are related to the people of so many countries we are charmed with the dances that come from their homes, and have made them our own, just as we have done with their folk-tales and their songs. So the American children of today have such a store of folklore, folk-songs, and folk-dances to delight and interest them as no children of other ages and countries have ever had.

DANCING THE BOHEMIAN "STRASAC"

This is part of the Bohemian folk-dance called the Strasac, which consists largely of stamping and clapping the hands. In the part of the performance here shown, the dancers place the right hand on the left elbow and shake the left forefinger at each other three times. Then each strikes his or her partner's hand and whirls to the left on the left foot.

FOOCHOW', CHINA. The name Foochow means in Chinese "the Happy City," and the traveler who steams up the River Min to this seaport, opposite the Island of Formosa, will easily understand why the beauty-loving Chinese gave it this poetical name. Entering the river through the Haitan Straits, the steamer for 34 miles threads its way between islands and mountains towering several thousand feet on each side of the river. When the city comes into view it presents a sight unique among Chinese cities, with its encircling walls, lofty wooded hills, and tall pagodas. The walled city lies two miles away from the river, but the intervening space is filled with a busy commercial suburb; for Foochow is the capital of Fukien Province and one of China's principal seaports. From the fact that spreading banyan trees have taken root in the crevices of the grass-covered brick walls, Foochow is also called by the Chinese "the Banyan City." The streets are narrow, but the tall hills on which are clustered temples and many-storied pagodas give a sense of spaciousness not usual in China. Two of the pagodas are more than a thousand years old —the Black Pagoda, built in 780 A.D. to commemorate the birthday of an emperor, and the White Pagoda, erected a century later.

One of the chief glories of Foochow is "The Bridge of Ten Thousand Ages," more than eight centuries old. It is a roadway 1,350 feet long built of enormous slabs of gray granite, some of them 45 feet in length, resting on piers of huge granite blocks so enormous that one wonders how they could ever have been brought from the mountain quarries. High stone parapets protect the throngs who are forever passing or stopping to crowd about the stalls on which food and cheap trinkets are displayed. As busy a tide of life flows beneath the bridge as on it, for the river is usually covered with boats, rafts, and barges.

Foochow first attracted foreign merchants with its famous tea. Population, about 625,000.

WHAT TO EAT *to Build Healthy Bodies*

FOOD HINTS FOR GROWING CHILDREN

Drink at least two cups of milk every day.
Eat freely of bread or cereal at every meal.
Eat some vegetable every day.
Do not eat sweets except at the end of a meal.
Drink at least six cups of water every day.
Do not drink coffee or tea at all.
Eat regularly three times a day.
Do not eat between meals—except an occasional light luncheon halfway between two hearty meals.
Eat slowly—chew your food thoroughly.

FOOD. Some day, if you are a boy, you will want to make your high school or college team, or go into the army, or be a fine doctor, lawyer, or engineer. If you are a girl you will want to play basketball, or be a trained nurse, a good mother, a teacher, or business woman; you will want to have good teeth, a clear complexion, and steady nerves. In either case the thing you will need as much as anything else is a strong body; and the kind of food you eat is about the most important thing in building it.

In New York City it has been estimated that between one-fourth and one-half of the school-children are undernourished. This is not due to poverty alone, because only a small proportion of the children come from families too poor to buy sufficient food. Ignorance and carelessness account for many more cases of malnutrition than poverty. Sometimes the cause is failure to chew the food sufficiently, but more often it is failure to get enough food of the right kind. For you know there are different kinds of food to use in building your body. Some of the foods, like some building materials, are for strength and some are for trimming.

THE RIGHT KIND OF A BREAKFAST

As pretty as a sunbeam, isn't she? One reason she looks so bright and happy is that she has the right things for breakfast; there is her orange, her oatmeal, the rich top milk for the oatmeal, the plain milk for drinking, the toast, and the butter.

The classes of food materials are: (1) *starches* and *sugars*, called *carbohydrates*, which are the chief source of heat and muscle energy; (2) *fats*, which are needed for bone marrow, for protective coverings, and filling in spaces between organs, and also to produce heat; (3) *proteins*, which are the real body builders (*see* Proteins); (4) *water* and *mineral salts*, called inorganic matter, the first of which makes up three-fourths of the weight of the body; and (5) *vitamins*, which have recently been discovered to be essential to proper growth and preservation of the body, although nothing is known of their chemical nature (*see* Vitamins).

All foods are made up of two or more of these classes. Some, like potatoes and rice, have a great deal of starch and water and some mineral matter; some, like dates and raisins, have a large amount of sugar, Bacon and olive oil are almost all fat; lean meat, cottage cheese, and white of egg are mostly protein. Nearly all green vegetables and fruits have a great deal of water in them and much of the minerals that the body needs. Butter, cream, and eggs are rich in one sort of vitamins, and another kind is found in fruits and other common foods.

Each day your body uses up, whether you are sleeping or playing or working, so much energy; and this amount of energy must be put back by means of the food you eat, or you can't grow or even keep the weight and strength you already have. Food provides fuel for the body, just as coal provides fuel for the steam engine. Its value is estimated in terms of the same unit that is used to measure heat—the calory. A calory is the amount of heat which is required to raise the temperature of one pound of water 4° Fahrenheit.

Fats rank highest in fuel value. They average about 4,080 calories to the pound. Proteins and carbohydrates contain about 1,820 calories to the pound. In other words, a pound of the fat of meat or butter has more than twice as much fuel value as a pound of lean meat (protein) or of sugar (carbohydrate). Also the body uses up fats more slowly.

A full grown man at moderately hard muscular work needs food with a fuel value of about 3,800 calories a day. A child of nine or ten needs only about half as much, while a child under two needs less than a third this quantity. Active boys generally require about 10 per cent more than girls of the same age.

THIS IS HER DINNER

She has, as you see, one ball of Hamburg steak, a baked sweet potato, two slices of bread with a tablespoonful of butter, creamed peas and carrots, bread pudding, and a glass of milk.

The fuel values per pound of some of the common foods, according to Mary S. Rose, are as follows.

	Calories per Pound of Edible Uncooked Material		Calories per Pound of Edible Uncooked Material
Beef, fresh, lean	709	Sugar, granulated	1,814
Cheese, cottage	448	Eggs	672
Bacon	2,836	Bread	1,174
Cream, thick	1,727	Milk, whole	314
Salt pork	3,555	Oatmeal	1,810
Walnuts, English	3,199	Cabbage	143
Apples	285	Celery	84
Bananas	447	Cucumbers	79
Dates	1,575	Watermelon	137

From this table it is easy to see that we could not depend on celery for our daily food supply, as it would be hard to eat even a single pound of celery and a man would require more than 25 pounds a day to provide the necessary calories. It is also evident that some foods are cheaper fuel than others.

Growing boys and girls should have much milk and bread, especially bread made of whole wheat or graham flour, and more butter, cream, and sweets of wholesome kinds, than adults usually eat.

Eggs, cottage cheese, nuts, milk, peas, and beans, all have a large amount of protein, which is necessary for building strong bodies. All of these are better for you than much meat, and take the place of meat.

Special Value of Vegetables and Meat

Green vegetables and fruit are needed in the diet, because they add bulk and "roughage" to keep your bowels active, and give the mineral salts which make red blood, good teeth, strong bones. They also give back to your body much of the water which it loses through perspiration and other natural means.

The foundations of your meals are made mostly of starch (bread, potatoes, rice, macaroni, and all cereals). The more whole-grain cereals (oatmeal, brown rice, whole wheat, stone-ground cornmeal) you eat, the more strength you will get from them. Most of the minerals in grains are in the outer husk. When this is all taken off in the milling, you are losing the minerals, and also losing the bran, the outside coating which helps to prevent constipation. If you eat what your mother would call a "sensible meal" you will probably eat just about the right amounts of the different kinds of food. If you eat all one kind of food, just because you like it best, you are giving your body only part of the material it needs for strength.

You need sweets, but not in the form of cheap or rich candy. Honey, raisins, dates, molasses, pure homemade or store candy, sweet chocolate, jellies, and jams, are all good for you in moderate amounts, eaten after a meal of sensible food. They are the trimming of your body-house and when used for trimming are fine, but when used for foundation stones they are just as undependable for strength as cardboard and lath.

As to the Fat You Need

The amount of fats that you need depends a great deal on the time of year, the climate you live in, and the kind of work you are doing. Fats of all kinds, butter, oil, fat from meat, fat from nuts, all give a large amount of heat and energy; and more of them are needed in cold weather or a cold climate than in warm weather or a warm climate. More of them are needed by a person doing outdoor work than by one in school or an office all day. The Eskimos eat

AND THIS IS HER SUPPER

For supper she has potato soup, two slices of whole wheat bread with butter, stewed apples, and six small molasses cookies.

chunks of fat and even tallow candles because they need the extra heat in their cold climate. So in winter fat meats and fried foods taste better than they do in hot weather. If you don't spoil your natural appetite by eating much candy and cake and other "trimming" foods, you will probably want to eat pretty much the food which is best for you.

Pure water is just as needful to build a healthy body as food is. It has no food value—that is, you could not live on it or get strength from it; but it helps you to digest your food and puts back in your body all the water it loses during the day. Some water you get in your food, but you should drink at least six glasses of water during the day besides.

Now you see how easy it is to build a strong body if you eat the right foods in the right proportion. Poor and one-sided diets cause many serious diseases, such as beriberi, pellagra, and scurvy. Here are the foundation stones and the materials to build the walls straight and sturdy:

Starches: Bread, rice, macaroni, oatmeal and other cereals, potatoes.

Milk (with all the cream in it).

Eggs: Boiled, poached, scrambled are better for you than fried.

Meat: Lamb, beef, chicken, fish are the best for you.

Vegetables: Spinach, carrots, beets, cabbage, and other fresh vegetables.

Fats: Bacon, butter, olive oil, nut butters.

Jam, jelly, candy, cake, are the trimmings to add to your diet; but keep them in their proper place as trimmings.

In preparing food, you must remember that the method of cooking plays almost as important a part in getting food value as the selection of the food itself. Some important food constituents dissolve in water, and so may be lost unless care is taken to preserve them. This applies to most fresh vegetables, and for this reason the water in which they have been boiled should be served with them. Careless cooks often throw away the best part of a dish.

A DAY'S DIETARY FOR A CHILD TEN YEARS OLD (FUEL VALUE, 1,875 CALORIES)*

	Measure	Weight in Ounces	Protein Calories	Total Calories
Breakfast				
Orange	1 large	9.5	7	100
Oatmeal	¾ cup	6.0	12	75
Top milk (10 oz.)	¼ cup	2.1	9	100
Milk	¾ cup	6.4	24	125
Toast	2 slices	1.0	14	100
Butter	½ tblsp.	0.3	..	50
Dinner				
Hamburg steak	1 ball	1.3	41	75
Baked sweet potato	1 potato	4.5	9	150
Bread	2 slices	1.3	14	100
Butter	1 tblsp.	0.5	..	100
Creamed peas and carrots	⅔ cup	5.0	14	75
Bread pudding (with raisins)	¾ cup	6.0	18	200
Milk	¾ cup	6.4	24	125
Supper				
Potato soup	¾ cup	6.3	22	150
Whole wheat bread	2 slices	1.4	16	100
Butter	½ tblsp.	0.3	..	50
Stewed apples	⅔ cup	5.0	1	100
Molasses cookies	6 very small	0.7	6	100
			231	1,875

*From 'Feeding the Family', by Mary S. Rose.

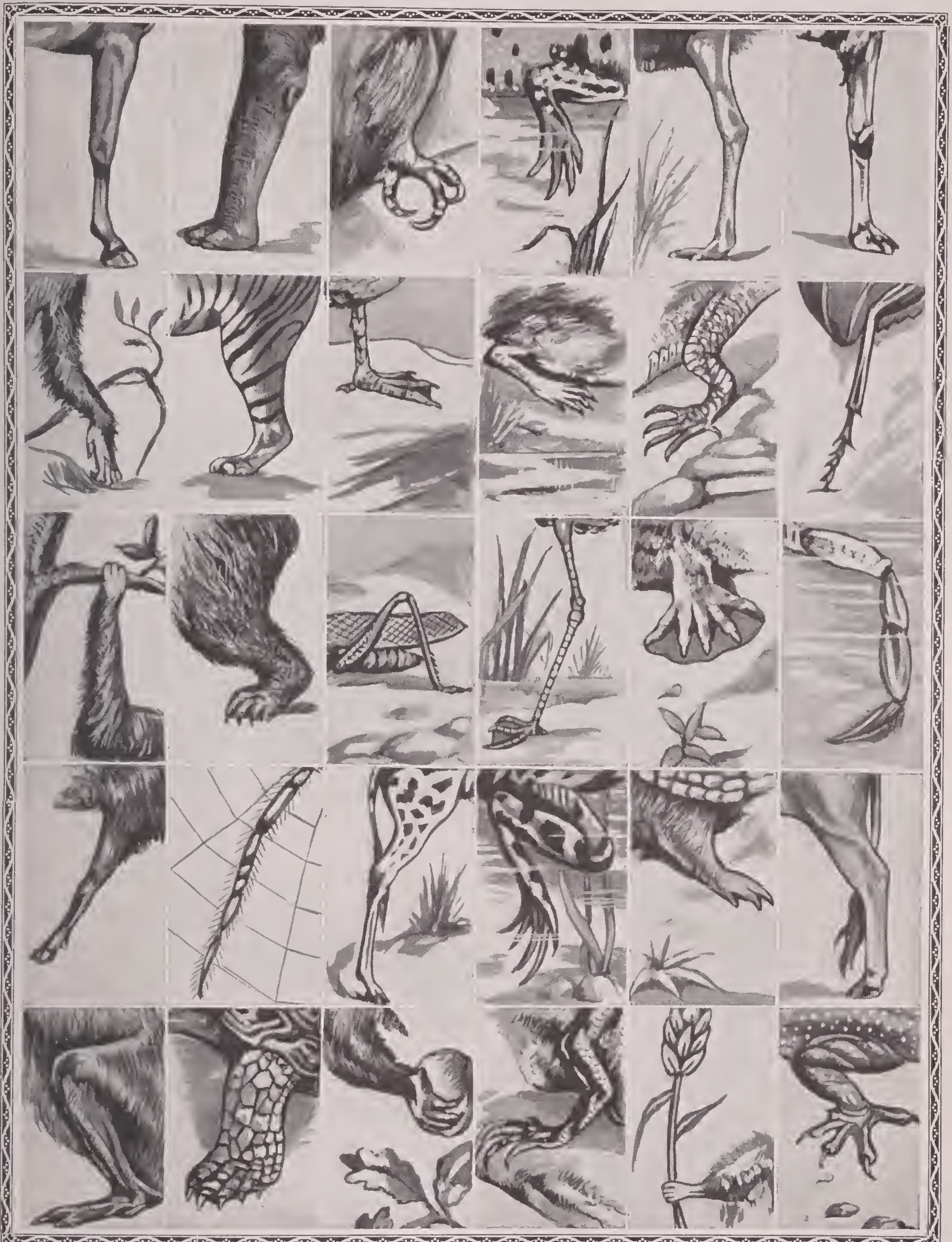
FOOT. In the lowest forms of animal life we do not find special organs for locomotion. In the case of the one-celled animals, such as the amoeba, a bit of the living substance is pushed out and then the remainder of the body is pulled up to it. The movement of the worm is somewhat similar; one section of the body is thrust forward and then the other parts are brought up by a creeping or crawling motion. As we ascend the scale of animal life we find definite organs developing whose business it is to move the animal about. Feet and legs begin to make their appearance, usually four or more, by which the animal moves from place to place.

A comparison of the foot in various animals brings out many interesting modifications. In the human foot we distinguish the ankle (*tarsus*), the instep (*metatarsus*), and the toes (*phalanges*). Man's heel rests upon the ground, and this condition is called a "plantigrade" foot; the bear also has such a foot. Other animals, like the cat and dog, walk on their toes or digits, giving a "digitigrade" foot, with the heel up in the air and the instep lifted away from the earth. In deer, cattle, horses, and some other animals the elevation of the heel has been carried further, and the animal stands on the tip-end of a single toe; the heel, instep, and digits are then away from the earth, the tip-end of one toe only being in contact. The heel bone, to which is attached the "tendon of Achilles," can be clearly seen in each of the three.

The horse has the most remarkable example of a modified foot. Not only are the heel and instep off the earth, but the bones of the instep have become reduced to one, and the animal walks upon the tip of a single toe on each of his four feet. But it has been shown by fossils in the rocks that the horse's foot has been derived from that of an original five-toed ancestor, by suppression and consolidation of parts. It is estimated that the geological history of these changes in the horse extends over a period of more than two million years. (*See* Horse.)

The animals which have feet most nearly resembling

THIRTY FEET! HOW MANY DO YOU KNOW?



Just as a good shoemaker makes shoes to fit the feet, Nature makes feet to fit the needs of each individual animal. How many of these feet could you name? They are, from left to right, first row—Horse, Elephant, Eagle, Newt, Ostrich, Camel; second row—Chimpanzee, Tiger, Duck, Water Shrew, Lizard, Tiger Beetle; third row—Sloth, Bear, Locust, Flamingo, Duck-billed Platypus, Crab; fourth row—Peccary, Garden Spider, Giraffe, Frog, Armadillo, Ox; and fifth row—Kangaroo, Box Tortoise, Squirrel, Iguano, Harvest Mouse, Gecko.

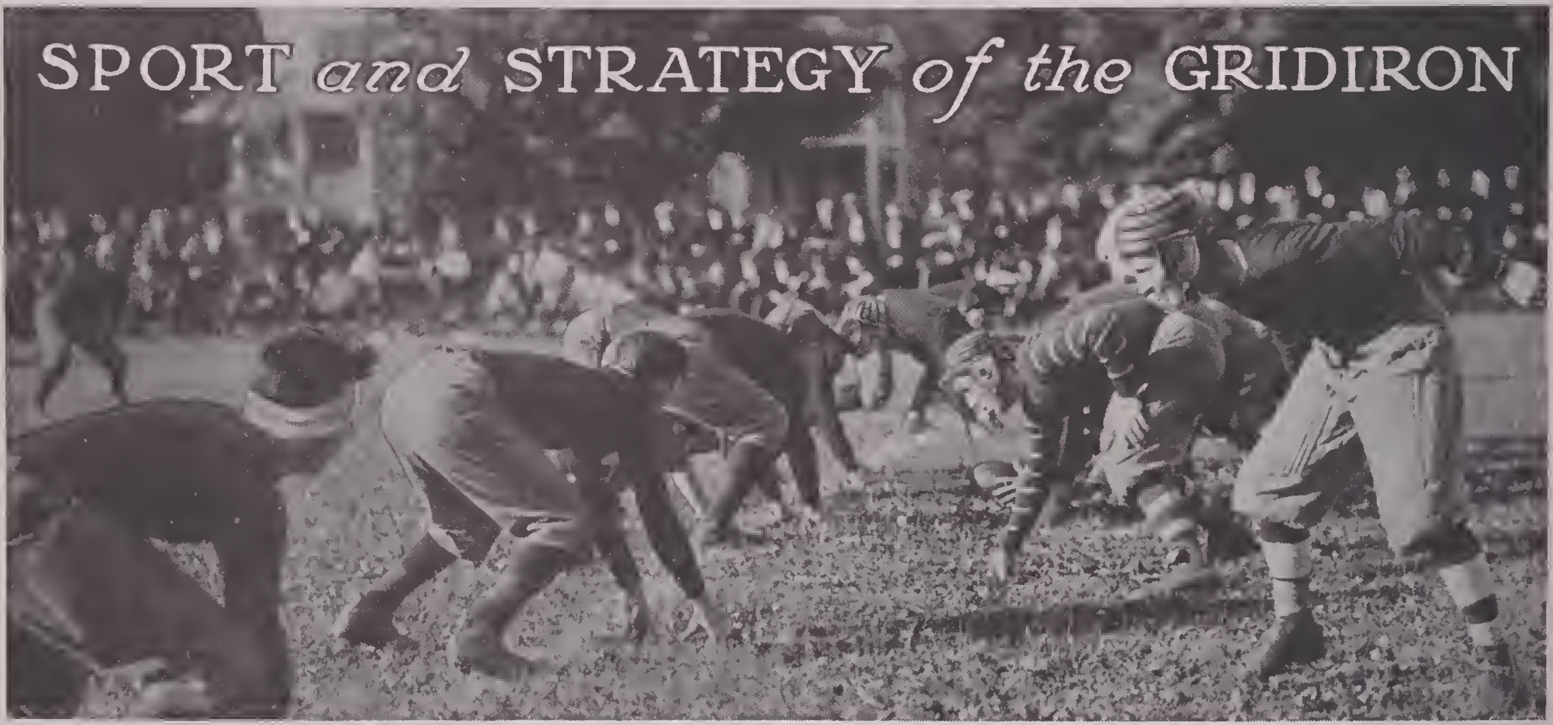
those of man are the monkeys and apes. But their feet are more like hands, for the great toe can be used like a thumb, and there is no arch in their feet, such as man has developed. Indeed the arched instep, adding spring to the step, is one of the things which distinguishes man from the beasts.

An Indian "toes in" as he walks—that is, his weight is thrown on the ball of the foot first. This adds grace, ease, and speed to his movement. The negro—often carrying a heavy weight—walks more flat-footedly. If the toes point out in walking, the proper leverage is impossible, for this is the position of rest, or weight-bearing, when the person is standing still. "Flat-foot," often a serious defect, is caused by the breaking down of the bones which compose the arch of the foot. It can be remedied by the wearing of proper supports. The wearing of shoes which are large enough and with broad low heels is one of the conditions of healthy feet.

The process of walking has sometimes been compared to the rolling of a wheel, with the legs as spokes. As the body moves forward the feet are constantly moving on, so that two spokes are made to serve the purpose of a complete wheel.

The foot as a measure of length comes from the assumed length of the human foot, and is very old. The Greek foot was 12.45 inches long, the Roman 11.65 inches, and the French foot 12.8 inches.

SPORT *and* STRATEGY *of the* GRIDIRON



BASEBALL is often spoken of as the great American game, but football, perhaps, is even more typical. There is something about the vigor, the strategy, and the exacting requirements, mental and physical, of football that make it the best loved of all the sports which Americans have developed. The fact, too, that in America football is played almost exclusively by amateurs, and usually by school and college teams, separates it still further from baseball, which is at its best as a professional game. The chief facts concerning this most fascinating of games are here clearly presented.

FOOTBALL. For most Americans football means what is known as American Intercollegiate football, a development of the old game of Rugby which was introduced from England about 1870. Each fall school and college teams in every part of the land play this national game, and as each year passes the number who take part in the sport increases. There are small games between grammar schools and high schools, with only a few spectators, and more important contests between colleges and universities all over the land, reaching their climax in such great games as those between Harvard, Princeton, Yale, the great western universities, West Point and the Naval Academy, with thousands of spectators.

Difference between Rugby and American Football

The English Rugby game is essentially a kicking and passing game, somewhat like a combination of basket-ball and American football. In the United States the game changed until it became largely a matter of advancing the ball by the aid of "interference" furnished by the teammates of the man carrying the ball, who run ahead of or beside him to protect him from opponents. The game rapidly developed into a science which offered full opportunity for strategy. Football coaches, like generals devising new stratagems, set themselves to the task of evolving unusual and surprising plays. One of the most powerful and famous of the formations devised was known as the "flying wedge," the principle of which was a V-shaped group of players guarding the carrier of the ball in the center. When a football "eleven" of heavy powerful men formed a flying wedge and swept down the field with almost irresistible force, many serious injuries resulted. As a result there came a reaction against the flying wedge and other mass plays; and a rules committee composed of representatives of the leading universities and colleges set about the task of freeing the game from unnecessary roughness and at the same time improving its many admirable qualities. Pushing and pulling by his teammates of the man who is carrying the ball were prohibited, and penalties were imposed for "piling up" on a player who is "downed," and for similar tactics. From 1906 on changes in the rules came in quick succession, one of the most radical being the introduction of the "forward pass," which opened up the play.

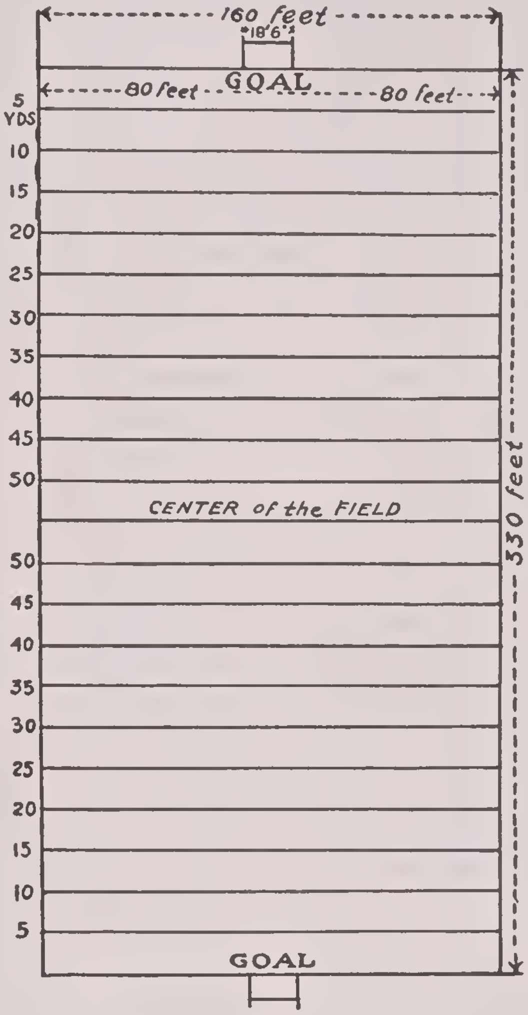


Diagram of a Football Field

The Field and the Ball

Football is played on a rectangular field, 360 feet long and 160 feet wide. The goal-lines, 30 feet from either end, are 100 yards apart, and in the middle of each goal-line there is a goal consisting of two posts 18 feet 6 inches apart, 20 feet high, with a horizontal cross-bar 10 feet from the ground. The space bounded by the goal-lines and the side-lines is called the "field of play," and is marked at intervals of 5 yards with white lines parallel to the goal-lines. The two spaces 30 feet wide back of the goal-lines are called the "end zones."

The ball is of leather, inclosing a rubber bladder which is tightly inflated. Its shape is that of a prolate spheroid with a circumference the long way of 28 to 28½ inches, and the short way of 22½ to 23 inches. Its weight is from 14 to 15 ounces. Each team is composed of 11 players. Seven are stationed on the "scrimmage line" as follows: left end, left tackle, left guard, center, right guard, right tackle, right end; and four behind the line, making up what is known as the "backfield"— quarter-back, right half-back, left half-back, and full-back.

The game lasts for 60 minutes of actual play, divided into four periods of 15 minutes each. This time is exclusive of the "time out" granted by the referee on account of injuries to players or for other reasons. By mutual agreement, shorter periods are often arranged. Between the first and the second periods and between the third and the fourth there is an intermission of one minute. Between the second and the third periods there is an intermission of 15 minutes.

The following plays count in scoring: touch-down, 6 points; a goal kicked from touch-down, 1 point; a goal from the field, 3 points; a "safety" (see below), 2 points. At the start of a game the two captains toss a coin to determine the goal each shall defend. The winner of the toss usually makes his choice so that his team shall have the wind at its back as an aid to punting.

Now, Just Watch This Game

Let us suppose that the game is between two teams, known as the Reds and the Blacks, and that the Red captain wins the toss and elects to defend the north goal. Suppose that the Black captain then elects to receive the "kick-off." The Black team immediately spreads out over the south end of the field and the Red captain places the ball on a little mound of earth in the middle of his own 40-yard line. The Red team forms in a single line stretching across the field just behind the 40-yard line. At the sound of the referee's whistle one of the Red players kicks the ball as far as he can into the Black team's territory. While one of the Black players catches the ball and attempts to carry it toward the Red goal-line, the whole Red team charges down the field to tackle him. Perhaps the Black player who catches the leather oval makes 20 yards before one of the Red players breaks through the Black interference and brings him to the ground.

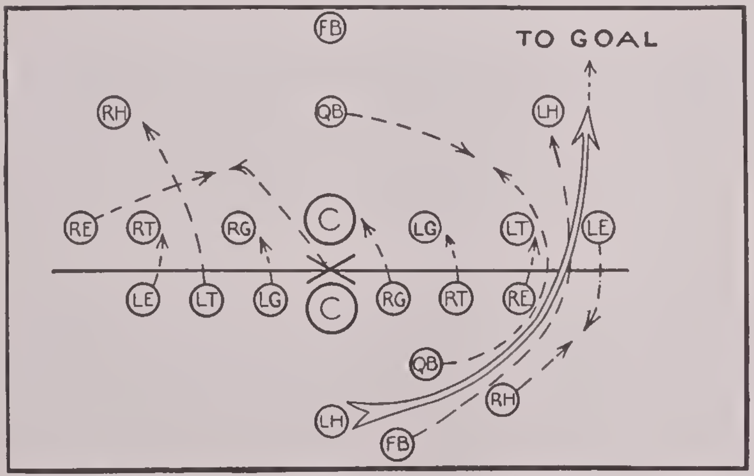
The two teams now line up in "scrimmage" formation where the ball was downed. The centers, guards, tackles, and ends face each other in two lines the length of the ball apart, with the quarter-back, full-back, and two half-backs in the rear of each team. The Black quarter-back calls out a signal—a series of numbers, such as "27-61-5," which indicates to the members of his team what the play is to be. The center, who is crouched over the ball, snaps it to one of the backs. The latter either carries it forward himself or passes it to some other player who attempts to charge through the Red line or to circle the ends. The Blacks must make 10 yards in four attempts or lose possession of the ball. If they make 3 yards on their first try, 5 yards on their second and 4 yards on their third, or a total of 12, they have thereby gained "first down," and once more have four tries to make the 10-yard distance. In that way the Black team, if successful, may march down the field, now making 2 or 3 yards, now making 10, 15, or 20 at a single rush, until it has scored a touch-down by crossing the enemy's goal-line. It has then earned 6 points; and by kicking the ball between the goal posts and over the cross-bar from a point 15 yards in front, it may add 1 point to its score, making a total of 7 points.

If the Blacks are not so successful in their progress down the field, and are able to make only half a dozen yards in three tries, they find themselves faced with the necessity of gaining 4 yards in a single attempt. In such case a team which has failed to penetrate beyond its opponents' 30-yard line usually elects to "punt." The full-back or one of the other players who is a good kicker steps to a point about 10 yards behind the line of scrimmage, receives the ball on a direct pass from the center, and punts far down the field (in the case of a good kick, 50 or 60 yards). The Red quarter-back and one of the other Red players, expecting this play, have remained far in the rear of their line. One of them makes the catch and immediately dashes toward the Black goal-line. Usually he is brought to the ground by one of the Black ends before he has covered more than 15 yards. But the ball is then in the possession of the Red team; it is "first down" and the Reds in their turn must make 10 yards in four tries. If a team in possession of the ball fails to make its 10 yards in four tries and fails to kick, the ball goes to the other team at the spot where it was last downed.

Frequently the team on the offensive makes use of the "forward pass." The back-field player who has received the ball hurls it over the heads of his opponents toward one of his team-mates, who attempts to catch it and carry it toward the enemy's goal. Very often, of course, the pass fails and the ball drops to the ground. When this happens it counts as a down and the scrimmage line forms at the point where the ball was previously downed. Should the ball, however, be caught by one of the opponents, the offense immediately becomes reversed, as in the case of a punt. When the ball is fumbled it belongs to the team which recovers it.

Suppose the Red team, by a series of end runs and plunges through the Black line, has brought the ball to the 20-yard line, and that there the Blacks hold strongly and the Reds are unable to advance. In such a case the Red team in all probability will attempt a "drop kick." The player chosen to try for the field-goal steps back 10 or 12 yards, receives the ball on a direct pass from the center, drops it in front of him and kicks it as it touches the ground, sending it toward the goal posts. If he is successful in kicking it between the posts and over the cross-bar he scores three points for his team. Somewhat similar is the "kick from placement," which may be used in the same situation as the drop kick; it is also allowed when a player who is receiving a punt signals for a "fair catch" and, having caught the ball, makes no attempt to advance it. The ball is held on the ground by one player and kicked by another. If it crosses the goal posts, it scores three points.

A SIMPLE PLAY IN FOOTBALL



This diagram illustrates a simple "off-tackle" smash. The play starts with the ball on the scrimmage line at the point marked by the cross. The center passes it to the "left half," who runs out to one side and then "cuts in" toward the opponent's goal. The large arrow shows his intended course. The dotted arrows show the courses the other attacking players take in order to block defending players away from the runner. The "right half" and "right end" turn the defending "left end" and "left tackle" toward the right and left respectively. Through this "hole" in the defense the "quarter back" and "full back" come to block off other defenders, and last of all comes the runner with the ball.

The only other scoring—a "safety"—is made when a player in possession of the ball is forced to the ground behind his own goal by an opponent, the impetus which sent the ball there having originated with one of his own side. When the ball is kicked or carried over the side-lines, it is brought 15 yards back into the field, opposite the point where it went over the boundary. After a score has been made the ball is brought to the 40-yard line and kicked off as at the beginning of the game.

There are penalties for various prohibited acts, varying from a loss of 5 yards to a loss of half the distance between the point where the ball is in play and the goal-line. The two most common penalties are the loss of 5 yards for being "off-side"—that is, being ahead of the line of scrimmage at the moment the ball is snapped back; and a loss of 15 yards for "holding" an opponent while on the offensive.

The officials are a referee, who has general oversight and control of the game; an umpire, who has charge of the conduct and position of the players; a linesman, who supervises the marking of the distance gained or lost in the progress of play; and a field judge, who acts as an assistant to the other officials.

Anyone watching a football game for the first time is puzzled by the manner in which the team in possession of the ball manages to conceal the direction of its attack. The ball is snapped back by the center to one of the backs, and the entire team springs into action so swiftly that the inexpert spectator loses sight of the ball. Surprise is a characteristic element of football, and that, perhaps, is one of the greatest reasons why the game has won such a place in America.

How Association Football is Played

Association football ("Soccer") is played with a round ball and differs from the American Intercollegiate or Rugby game most radically in that the ball is never carried or touched by the hands except by the goal-keeper. It is advanced chiefly by kicking, and a goal is scored when one team kicks the ball underneath the cross-bar of the goal posts, which are 8 yards apart and 8 feet high. As in basketball, a player who is off-side may not touch the ball. There are 11 men on each side, and the field is from 100 to 130 yards long by 50 to 100 yards wide. In England this is the great game, and in America it is played by many teams representing industrial organizations.

Rugby Union football is played by 15 men on a side. The ball is oval as in the Intercollegiate game, and it may be carried, thrown, or kicked. The scoring is done by carrying the ball into the enemy's goal and by kicking it over the cross-bar of the goal-posts.

The LIFE-GIVING WOODLANDS *and Their* FOES

IN MANY regions which are now arid and barren, dense forests once covered the mountain slopes and valleys. Beautiful streams rising in their swampy reservoirs were fed by the waters that slowly seeped from the forest floor and flowed through the land, keeping the soil moist and fertile. But men came and stripped the hills of their forest covering. Now when the rains fall the streams become swollen and carry off the water in torrents, flooding the valleys and covering them with sand and gravel. The hot sun quickly draws the moisture from the ground, and the springs and the streamlets dry up, leaving empty beds. Successive droughts soon kill the vegetation, and in a few years once fertile areas become barren waste lands. This article tells you something about these beneficent gifts of Nature and the efforts being made to protect them.

FORESTS AND FOREST PROTECTION. Next to the earth itself the forest is man's most useful servant. Not only does it preserve the earth's moisture, regulate the flow of streams, and moderate the winds; it also supplies him with wood and wood products, without which he could have made little progress in civilization. In their relation to climate the forests may be considered great natural reservoirs, which accumulate the rainfall in the thick covering of decaying humus beneath the trees, while the heavy foliage, shutting out the sun, prevents evaporation. It is interesting to note that the very word "forest" comes from a Latin word (*foris*) which means "out of doors" and suggests something of the broad spaciousness and charm of nature's wonder growths.

There are many types of forests scattered over the world. Some are composed chiefly of "conifers" or evergreen (needle leaf) trees. Others are made up almost entirely of "deciduous" or hardwood (broad leaf) species; while others are mixed, having trees of different kinds. The latter type is most common. The wooded area of the United States, which covers about 30 per cent of the surface of the country, is divided into two grand divisions, which may be called the Western and Eastern forests. Between these areas lie the great treeless plains of the Middle West.

Wealth of the Forest Lands

The Eastern forest area is divided into three distinct subdivisions—the northern, central, and southern forests. The northern forest is remarkably dense and contains a great amount of merchantable lumber. In the Great Lakes region and in the state of Maine are found an abundance of conifers, pine, spruce, and hemlock predominating. In the uplands are found forests of hardwoods, mostly maple, birch, and beech. These northern forests are very beautiful, especially in the fall when the frost turns the leaves of the hardwoods to brilliant hues of yellow, red, and brown, in strong contrast with the dark foliaged conifers. This same type of forest is also found in Canada. In the central woodlands there is a marked absence of conifers, but the same hardwoods are there found as in the northern forests, together with oaks, sycamores, chestnuts, ashes, and hickories. The southern forests are mixed conifer and hardwood, but the species of both these groups differ from their northern kindred. The long leaf or yellow pine, the bald cypress, and the white cedar are among the characteristic conifers, while oaks and gums are the prevalent hardwoods. The forests here are less dense than the northern, having been frequently burned over in many regions.

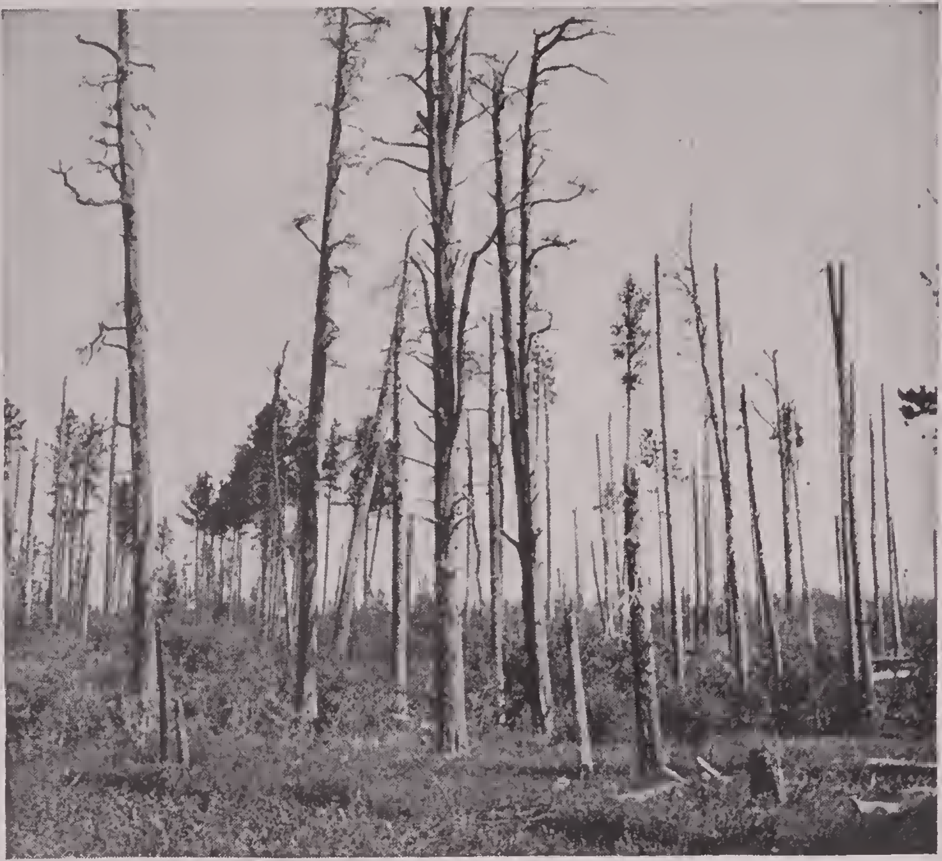
The western forests are marked for their beauty and the gigantic proportions of much of the timber. Sequoias, redwoods, firs, pines, and spruce are among the giant conifers found on the Pacific coast. The magnificent sequoias of California are truly the "big trees" of nature's finest forests, some specimens towering to 400 feet (*see* Sequoia).

The forests of Europe do not differ greatly from those of the eastern United States. Oaks and beeches abound in England, France, and Germany, while in the North and on the mountains are found pines, firs, and other conifers.

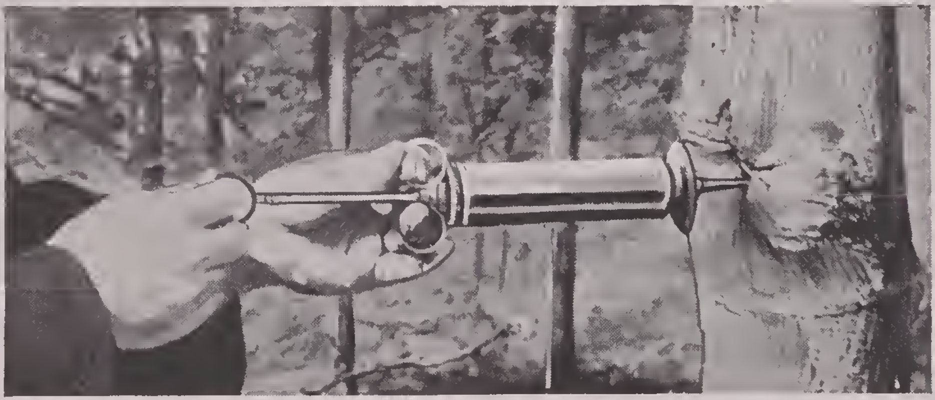
The Life Struggle in the Forest

The life of a forest is very interesting. Each tree must continually fight for its right to live, for on every side are other trees crowding and groping outward and upward for the light and air which, together with the moisture taken from the earth, are essentials to its development. Tall trees are continually sending out new branches in search of light, the lower branches dying as the heavy foliage shuts away the light and air. This accounts for the bareness of the trunks of forest trees, the dead limbs having been shed in the process of growth. The evergreens, with their conical tops, grow closely together, for the light falls on their tops from all angles and therefore they do not need much space. The hardwoods in the forest grow farther apart, for their broad tops require more room in which to spread.

FIGHTING THE INSECT ENEMIES OF TREES



This view of a stretch of ruined forest shows the damage insects do to standing timber when they get a chance. The picture was taken in South Dakota, and shows the results of the ravages of the pine bark beetle some years before. The trees were killed by the insects and are now rotted and broken.



The forest rangers fight insect pests by encouraging the growth of natural enemies, by spraying, by isolating infected areas, and many other means. In this picture a forester is injecting "medicine" into a tree, just as physicians inoculate their human patients against certain diseases. This fluid will protect the tree against boring insects.

Of all the foes that attack the woodlands, forest fires are the worst. They spring from many sources, sometimes kindled along the railroad tracks by flying sparks or started by a lighted match carelessly dropped. Settlers in clearing their land often start fires in the dry leaves and needles which sweep for mile after mile, destroying the young growth and injuring the larger trees. At times forests have been deliberately fired by sheep owners in order to extend the area of pastures, and berry pickers have been known to burn away the undergrowth to insure a better crop of berries in after years. Reckless lumbering is the next worst enemy of the forest, for through carelessness in felling the timber, many fine young trees are lost. That the logs may be more readily removed the lumbermen often deliberately slash away the young growth. Large limbs and tree tops are also left where they fall, smothering the seedlings and affording brush heaps to feed the next forest fire.

Grazing harms the forest in several ways. The first and most injurious is the burning to produce new pasture. Thousands of acres have been laid waste in this manner. The animals also trample the delicate rootlets. Sheep are especially harmful, for they eat every vestige of vegetation, leaving the ground bare. Cows and horses browsing on the leaves and twigs will eventually kill not only seedlings but vigorous trees which have boughs within reach.

Wind storms, especially in the United States, also do a great deal of damage, often felling a wide path of giant trees, splintering the trunks and making them useless for lumber, and piling up material for forest fires. Insects are constantly injuring the woodlands, whole regions becoming infested with the pests which eat away the leaves or bore into the trunks, destroying old and young growth alike. The gypsy and brown-tail moths, the pest of the New England forests, are among the worst, and millions of dollars have been spent in an effort to exterminate them. Fungi and parasitic growths of various sorts are also detrimental, the white pine blister and the mountain blight having destroyed huge tracts of valuable lumber.

Long ago men began to recognize the vast national importance of the forests, and steps were taken to prevent their ruthless destruction and to promote reforesting. Throughout Europe, especially in Germany, forestry or forest protection and cultivation has been reduced to a science and has for some time been an economic factor of great importance. (*See* Black Forest.) In the United States the supply of timber was apparently so inexhaustible that almost no steps were taken to prevent reckless lumbering until the latter part of the 19th century. In 1891, realizing the necessity not only to prevent reckless lumbering but also to provide for future needs, Congress granted the president the right to create forest reserves or national forests.

ON THE LOOKOUT AGAINST FOREST FIRES

The United States Forestry Service tries to nip forest fires before they get under way, keeping watchers throughout the forest regions. Here you see a young woman on guard in a comfortable watch tower, scanning the horizon for the first symptom of fire. If she sees a wisp of smoke by day or a spark of flame by night, away go the fire-fighting crews to the scene. On the table behind the watcher is the "fire finder," an instrument which enables the worker to determine both the direction and distance of a blaze.

These watch towers, important as they are, form only one link in the chain of government protection against forest fires. They are like the sentinel posts of a mighty army, as you can imagine by looking at this picture of the Harney Peak Lookout in South Dakota, flying its flag in the face of a raging blaze. Behind them are the fighting forces—the forest patrols and the fire-fighting crews—and the whole organization is bound together by an elaborate web of telephone, telegraph, and wireless communication. Even airplanes are sometimes enlisted in the work.

VICTORY AND DEFEAT FOR THE FIRE FIGHTERS

Here the Forestry army, with pick and shovel, is checking a forest fire by digging trenches in its path.

Here the army arrived too late and the flames won the battle, stripping and laying low the forest.

In the same year President Harrison established the Yellowstone Park Timberland Reserve, the first national forest in the United States. Since that time more than 150 such reserves have been established covering an area which, taken together, would be as great as the areas of California and Minnesota combined. In 1911 an act was passed which provided for the acquisition of forest lands on the watersheds of navigable streams, and in accordance with this act the forest tracts of the Appalachian and White Mountains have been purchased. Prior to that time most of the forest reserves had been established in the West, where the land was still in possession of the government. In all these reserves nature is aided in every way in order that an abundant yield of lumber may be obtained every year. Though stringent rules have been passed regarding the destruction of trees, conservative lumbering is carried on in these reserves.

The Watchful Guardians of the Forest

If you should visit one of these forests, you would be sure to meet before long with one or more forest rangers. These are trained men employed by the government to guard and protect the forest. In the swaying top of a tall tree or from a lookout station on the top of a commanding hill, you would perhaps see a man intently scanning the surrounding woods through field glasses. Should he see the tell-tale smoke of a forest fire eating its way among the timber, he immediately spreads the alarm by telephone to other stations. Aid is rushed to the threatened point and with wet blankets, brush, and axes the fire is prevented from spreading. This system has been very effective, especially in the West, and most fires are extinguished without great loss to the reserve. A shift in the wind, however, often works great havoc, for the fire breaks out in other directions and sometimes many miles of forests and even villages are destroyed. Grazing is permitted in some forests, but if the rules are disobeyed the forest ranger reports the violation and the grazing permit may be cancelled. Should a ranger see signs of insect pests, reports are forwarded to Washington and experts are sent to fight against them. Men educated in the science of forestry also cultivate young trees, and use these to replant areas which have been lumbered over or where natural reproduction has been hampered.

Forest Rangers "on Wings"

The airplane has become a valuable aid in the care of the national forests, for with an airplane one forest ranger can cover more territory in a day than he could otherwise cover in weeks. It also assists the ranger to discern things that otherwise might escape the eye, such as illicit lumbering and grazing in out-of-the-way places.

State laws supplement the national regulations and many states have established forest reserves. Lumbermen also are beginning to realize the value of keeping the forests productive, and are introducing methods not merely to eliminate needless waste, but to save the young growth.

The Forest Service of the United States is a branch of the Department of Agriculture. Its objects are to preserve the timber resources of the country, and at the same time see to it that as many of the people as possible have an equal chance to use them. In addition to protecting the forests from fire and depredation and supervising grazing and lumbering privileges, the service conducts investigations at experiment stations and coöperates with states and individuals in furnishing advice as to the best way of managing their forest holdings. Similar duties are performed in Canada by a Director of Forestry, who is attached to the Department of the Interior.

FORGET-ME-NOT. Centuries before it grew in North America, this exquisite little blossom was cherished by the people of Europe and Asia as the emblem of true love and constancy. Of all the pretty legends that cluster about it, perhaps the happiest is this folk-story of the Persians, told by their great poet Shiraz:

> It was in the golden morning of the early world, when an angel sat weeping outside the closed gates of Paradise. He had fallen from his high estate through loving a daughter of earth, nor was he permitted to enter again until she whom he loved had planted the flowers of the forget-me-not in every corner of the world. He returned to earth and assisted her, and together they went hand in hand. When their task was ended, they entered Paradise together, for the fair woman, without tasting the bitterness of death, became immortal like the angel whose love her beauty had won when she sat by the river twining forget-me-nots in her hair.

Transplanted to America, the forget-me-not soon escaped from the gardens to adorn brookside, marsh, and low meadow. It grows from Nova Scotia to New Jersey and westward into Pennsylvania, where from May until August its clustered, pink-tinted buds unfold into the tiniest sky-blue blossoms with yellow eyes. The true forget-me-not, cherished the world over for love and remembrance, is this timid, moisture-loving, baby-blue flower of the woods. One may find, however, in dry fields or even on hillsides, a species of forget-me-nots with pink or white blossoms, and in greenhouses there blooms the dark blue species of the Azores.

Scientific name, *Myosotis palustris.* Flowers flat and 5-lobed, growing in long one-sided clusters, funnel-shaped corolla enclosing 5 stamens; calyx short and 5-cleft. Stems slender, hairy, 6 to 18 inches long. Leaves light green and lance-shaped, somewhat shiny on top and hairy underneath, growing alternately on stem.

FORMAL'DEHYDE. This gas is much used as a disinfectant because it is deadly to bacteria and is easy to use. Formaldehyde is composed of carbon, hydrogen, and oxygen (CH_2O), which will dissolve in alcohol or in water. A 30 to 40 per cent solution in water which contains some wood (methyl) alcohol is called "formalin." If a little sulphuric acid is added to a solution of formaldehyde, a white powder is formed, called "para-formaldehyde" or "paraform," which has the same percentage of carbon, hydrogen, and oxygen as the original formaldehyde. Paraform is convenient to handle and so is the usual commercial form in which formaldehyde is obtained. For disinfecting rooms paraform is volatilized over a lamp, or formalin is heated, and the formaldehyde rises in vapor. The odor is so pungent and irritating that weeks after a fumigation one's eyes will smart upon coming into the room. Formaldehyde will keep food from spoiling, but its use as a preservative is regarded as injurious and is prohibited by law in most states (*see* Antiseptics). It is also used extensively for the manufacture of artificial plastic materials like "bakelite" (*see* Coal-Tar Products).

FORMO'SA. Sailing off the coast of China in the year 1590, some Portuguese traders sighted an island whose wondrous beauty struck them so forcibly that they cried out, "Ilha Formosa! Ilha Formosa!" (beautiful island). A few years later the word "Formosa" appeared on the charts of Dutch navigators and at last became the accepted name of this semi-tropical island. The Japanese, to whom Formosa was ceded by China in 1895, call it Taiwan.

THEY DON'T "HUNT HEADS" ANY MORE

The savage inhabitants of Formosa used to enjoy the gruesome sport of collecting the heads of their enemies. The natives you see here, however, have been fairly well tamed, using those long knives now for peaceful purposes. Those bright-striped gowns are made by picking blankets apart and weaving the material on native looms, while the huge conical objects are the latest mode in Formosan hats.

The beauty of the island contrasts strangely with the savagery of the native inhabitants, who made the name Formosa terrible in the ears of sailors for many generations. For these muscular, broad-chested savages, with their huge hands and feet, large mouths, and broad flat noses, were cannibals and head-hunters; and until recently any unfortunate mariner cast away on the coast in the terrible storms that sweep the China Sea could expect no better fate than death.

But under the vigorous hand of the Japanese government these wild people have been driven into the mountain fastnesses, where they are hemmed in by high barbed-wire fences that can be electrically charged. The military patrols are moving these barriers up the mountain sides as fast as the hill people come to realize the friendliness of the ruling powers, and many of the reclaimed villages now have their schools and markets.

On the world map Formosa seems a tiny oblong speck off the east coast of China. In reality it is 235 miles long and 90 miles wide; its area of nearly 14,000 square miles is slightly greater than that of Maryland. Mt. Morrison (about 14,000 feet) is the highest peak in the Japanese Empire.

The island is rich in plant life. Wild flowers bloom the year round, many of them beautiful varieties of lilies, orchids, azaleas, rhododendrons, and other flowers which are commonly known elsewhere only as hothouse plants. In the southern districts grow such tropical fruits as the pomegranate, breadfruit, figs, guava, and oranges.

Tiger cats, Tibetan bears, deer, civets, wild boars, apes, armadillos, and squirrels abound. In all parts are found venomous snakes. One of the most beautiful of the many birds is the blue magpie, with its black head and neck, vermilion bill and legs, and blue and white body. The most important domestic animal is the water buffalo, which long ago was brought in from China as a beast of burden.

Farming is the chief occupation, and the principal products are rice, tea, sugar, sweet potatoes, jute, and turmeric (a root used as a condiment and as a yellow dyestuff). In the eastern part are forests of camphor trees, which gives Japan a virtual control of the world's supply of natural camphor. Gold, silver, copper, sulphur, and coal are mined in considerable quantities and within recent years petroleum has been produced.

With the adjoining group of about 50 islands, Formosa forms a province of the Japanese Empire. Taihoku is the capital. There are more than 300 miles of public railways and nearly 1,000 miles of private lines. Postal, telephone, and telegraph communications have been established, and a progressive system of education. The population is about 3,700,000, chiefly Japanese and Chinese.

FORT SUMTER. Like an electric shock flashed the news through the Northern states, on April 12, 1861, that the South had actually fired upon Fort Sumter, and that the long feared but scarcely believed in Civil War was at hand.

The United States government had commenced the building of this fortification on a small island in the harbor of Charleston, S.C., in 1829 and had named it for the Revolutionary hero, Thomas Sumter (1734–1832). But the country was at peace, there was no hurry, and the fort was still unfinished when South Carolina seceded on Dec. 20, 1860. South Carolina claimed that, with the dissolution of the tie which bound her to the Union, she had a right to all the United States' property within her limits. President Buchanan refused to hand over the forts within the seceded states, but agreed not to send reinforcements.

When the dispute began, Fort Sumter was unoccupied; but Major Robert Anderson soon moved his small garrison into Sumter from Fort Moultrie, a weaker fortification in the same harbor. Fort Sumter was really besieged from this time until the outbreak of the war. On April 11, Gen. P. G. T. Beauregard, in command of the Confederate forces, demanded its surrender. Major Anderson refused at daybreak, and on April 12 the bombardment began. Against overwhelming odds the Union troops held out until honor was satisfied. Major Anderson was forced to surrender on April 13, announcing his surrender in the following dispatch to Washington:

> Having defended Fort Sumter for 34 hours, until the quarters were entirely burned, the main gates destroyed, the powder-magazine surrounded by flames, and no provisions but pork remaining, I accepted the terms of evacuation offered by General Beauregard, and marched out of the fort with colors flying and drums beating, saluting my flag with 50 guns.

Men at the North who had calmly been saying, "Let the South go," were now aroused to fever heat and enlisted in response to Lincoln's call for 75,000 men. The North gained much in unity of action by the loss of Fort Sumter; the South gained only the fort, which however they held until 1865. When the Confederate forces abandoned Charleston in that year, Fort Sumter again passed to the North, but as a battered ruin of no military importance.

FORTUNA. The goddess of fortune was more worshiped by the Romans than by the Greeks, though they also recognized her under the name of Tyche. By some she was considered a sister of the Fates. She differed from them, however, in working without law, conferring joy or sorrow as she pleased. Greek poets and sculptors represented her with a rudder, with a ball or wheel, or with wings. The Romans proudly said that when Fortuna entered their city, she threw away her ball and put off her wings and shoes, to indicate she would remain forever.

FORT WILLIAM, ONTARIO. At the head of Lake Superior stands the thriving city of Fort William, three miles from its sister city, Port Arthur. Enormous grain elevators, looming large on the horizon, explain the reason for the existence of these towns; for the head of the lake is the funnel through which passes most of the wheat yielded to the world by the great prairies of the Canadian Northwest.

After the grain is harvested in Manitoba, Saskatchewan, and Alberta, long freight trains bring it to these great elevators. Port Arthur alone can store nearly 30,000,000 bushels at one time. From the elevators the grain is loaded on boat or train, as it is needed, and sent to the United States, to eastern Canada, or to England. Its advantages of location also make Fort William the greatest coal-handling center of western Canada. Flour mills, foundries, stove works, wood-working plants, shipyards, and many other industries have been attracted by the excellent shipping facilities of these twin cities.

The electric light plants, street railways, and telephone systems in both Fort William and Port Arthur are municipally owned and operated. The name Fort William recalls that the town was first a trading station of the Northwest Fur Company. In those days schooners lay awaiting their loads of furs, where today enormous steamers receive their burdens of wheat from rows of the biggest elevators in North America. Population of Fort William, about 25,000; of Port Arthur, 20,000.

FORT WORTH, TEX. Because of its location in the heart of northern Texas, with a rich farming country to the east and the great new oil fields and extensive cattle ranges to the west and north, Fort Worth has become one of the thriving and prosperous manufacturing cities of the state. Most of the trunk railway lines converge here, making the city one of the chief shipping centers of the Southwest.

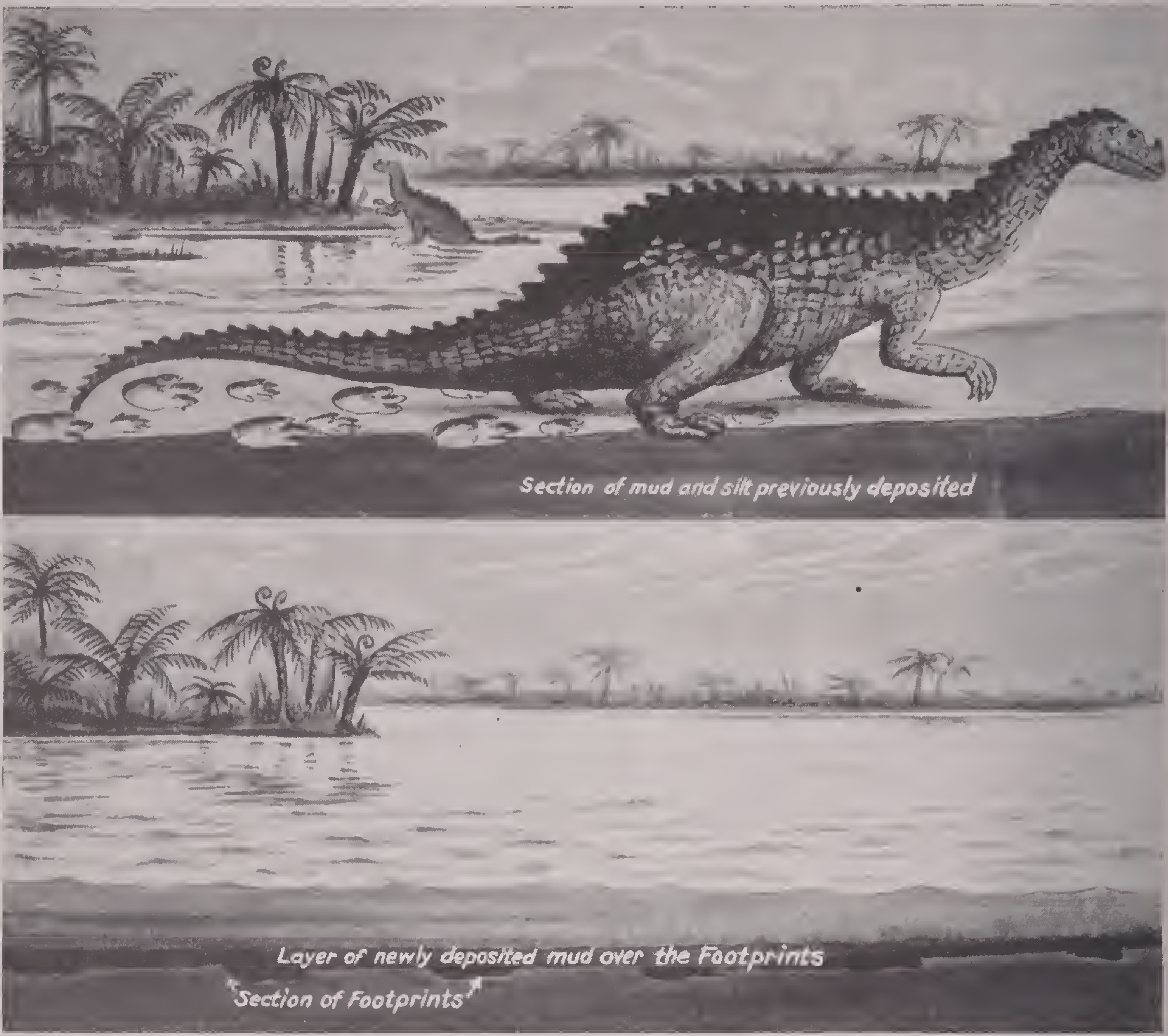
Fort Worth has been an important live stock center since the early days of its history, and today ranks as one of the largest markets in the United States for cattle, horses, and mules. It has several large meat-packing establishments, large railroad shops, and oil refineries. Other important industries are grain elevators, flour, cornmeal, and stock-feed mills, silo plants, cotton-oil mills, automobile assembling plants, manufactories of clothing, furniture, chemicals, wagons, etc. It is also the seat of Texas Christian University and Texas Woman's College and the Southwestern Baptist Theological Seminary. The development of the North-Central and West Texas oil fields gave a great impetus to the growth of the city, and a gain of nearly 50,000 in population in the city and suburbs was made in the three years following the oil discoveries of 1917.

The city is built on rolling country, and in its development advantage has been taken of this natural circumstance. There are more than 30 parks including Lake Worth, six miles northwest of the city, where an enormous dam 3,500 feet long has been constructed on the Trinity River to provide a reservoir for the city's water supply.

For a few years after the Mexican War, Fort Worth was a military post, to protect the sparsely settled country from the forays of the Indians. When the railroads began to reach the settlement in the late 70's and early 80's, the cattlemen made Fort Worth their headquarters, and its real growth began. Incorporated in 1873, the city adopted commission government in 1907. Population, about 110,000.

FOSSILS. Did you know that if you should start digging deep down under your own house, you might find the remains of strange animals and plants, unlike anything alive today—the bones of huge monsters that perished millions of years ago; the trunks of ancient trees turned to stone; the molded

TRACKS OF ANCIENT MONSTERS IN THE ROCKS


Section of mud and silt previously deposited
Layer of newly deposited mud over the Footprints
Section of Footprints

In far-off Jurassic times the climate of North America was moist and hot, and what is now prairie land was a swampy wilderness filled with soft marsh vegetation and fernlike trees. Through these forests and around the marshes roamed great reptiles, like the dinosaur in the picture. Most of the footprints they left in the mud were washed out; but occasionally the mud hardened, and then was overlaid with mud of another kind which did not unite with the lower layer. As time went on and more mud was deposited, its weight hardened the lower layers into rock and thus the footprints in the lower layer were preserved in their molds, to be dug up by modern geologists.

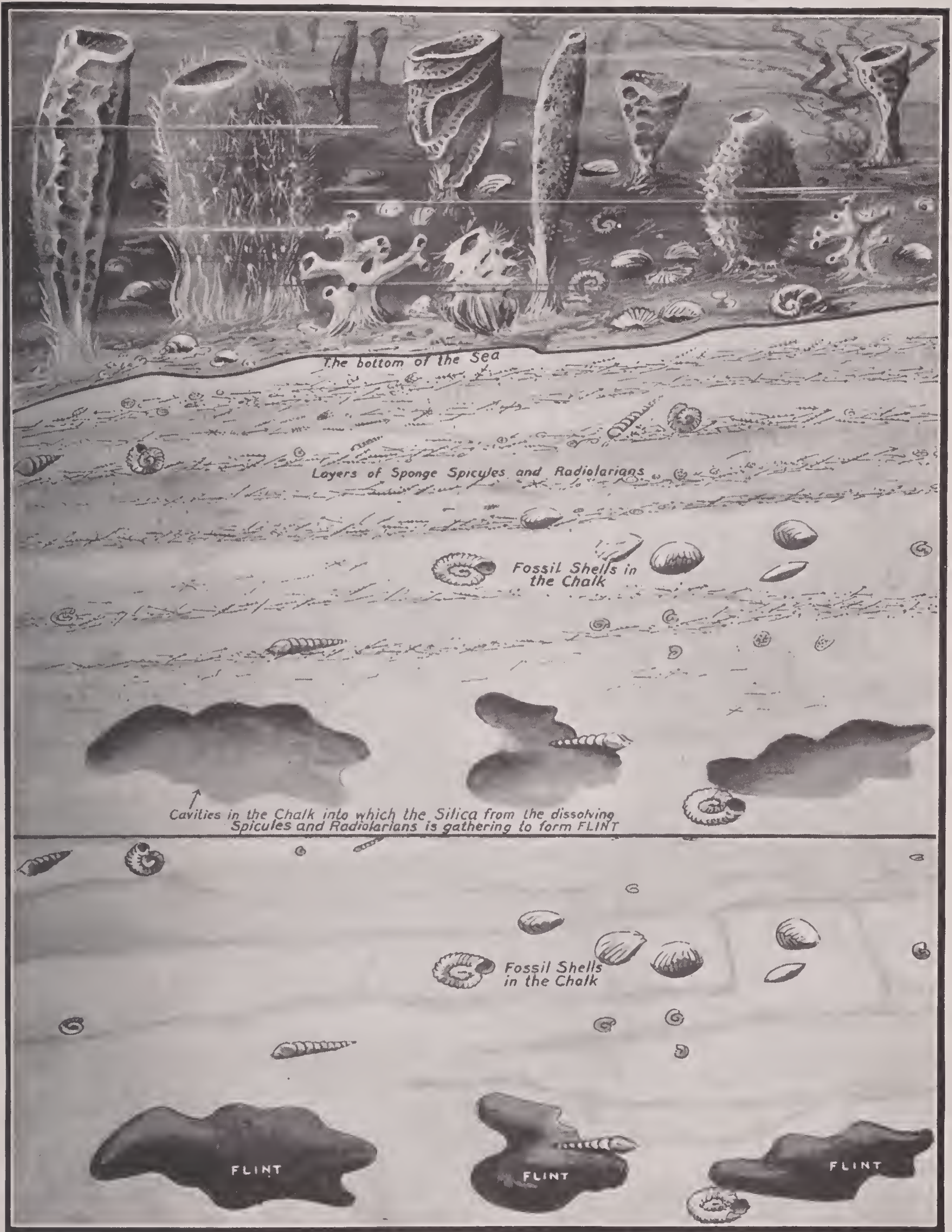
forms of huge insects, of queer fishes and shells, of birds with teeth, of real sea-serpents, of hundreds of other relics of bygone ages? Not all these things would be found in any one place, to be sure, but all such things have been found in places very widely distributed over the earth.

Such relics are called "fossils," from the Latin word meaning "to dig." By studying them, scientists have been able to piece together some of the most important pages in the history of the earth and its inhabitants. They have proved, for instance, that the rocks in the Rocky Mountains, the Alps, and the great Himalayas were once below the level of the ocean, for the remains of sea animals have been found high up on their slopes. From fossils we have learned also that the forebears of the camel once roamed the plains of North America; that tropical forests once covered the United States and Europe, and a luxuriant vegetation grew where the Polar regions now exist.

Fossils have told us that the great coal and chalk beds of the world were formed from the remains of living things, and that millions of years before the pyramids of Egypt were dreamed of, tiny animals were making shells which became the limestone of which parts of those pyramids are built.

Fitting together the scattered parts of the fossil story, science has traced animal life back to the earliest worms and shell-fish, and has shown how, one after another, appeared the cartilaginous fishes like sharks, the amphibians (half-land, half-water animals like the frog), the insects, the reptiles, the birds and bony fishes, the mammals, and, last of all, man.

HOW THE SEA MAKES ANIMALS INTO FLINT


The bottom of the Sea
Layers of Sponge Spicules and Radiolarians
Fossil Shells in the Chalk
Cavities in the Chalk into which the Silica from the dissolving Spicules and Radiolarians is gathering to form FLINT
Fossil Shells in the Chalk
FLINT
FLINT
FLINT

Did you know that the great factory of the sea actually makes the skeletons of sponges and other tiny animals (the "radiolarians") into masses of flint? The process is long but quite simple. The bodies of these animals fall to the ocean bottom. There they are buried under layers of chalk formed by the shells of other ocean creatures. In the course of time, cavities come in the chalk beds and the stony material (silica) left by the decay of the "spicules" composing the skeletons of the sponges and radiolarians seeps into these holes. Here it hardens and becomes flint. Sometimes these little bodies fossilize instead of dissolving, and it is by finding these fossils, both in the chalk and in the flint, that scientists have been able to learn the entire process.

Fossil plants and fossil animals are found in many forms. In some cases a fossil is only the footprint of some prehistoric beast in the mud of bygone ages which has been buried and preserved under a fresh layer of sand or silt. In some cases it is the delicate imprint of a leaf on some soft material which later hardened into solid rock. Sometimes the body of an animal was buried and decayed, leaving a hollow mold which filled up with mineral matter forming a cast of the animal's shape. Sometimes the bones and teeth themselves have survived in a favorable spot. In a few relatively recent cases even the flesh of the creature has been preserved, as in the case of the mammoths imbedded in the frozen mud cliffs of Siberia for thousands of years, whose meat was so fresh that it was said to have been eaten by the hungry natives of the region.

The science of fossils is called Paleontology, and to understand fully its importance you should read the articles on Evolution and Geology. Here, we can only mention some of the more amazing discoveries, mostly made within the last 50 years.

Queer Skeletons in the Family Closet

Many strange relationships have been made known, based upon the fossils of some of the animals which came into existence in the early days of the world's history. The seal and the elephant are believed by some men of science to have had a common ancestor, while such widely different creatures as the moose, the giraffe, the hippopotamus, the sheep, the pig, and the camel, are said to spring from the same class of primitive mammals, whose bones now rest in our museums. The ancestor of the modern horse, which was a tiny creature no bigger than a fox-terrier, was a close relative of the rhinoceros family (*see* Horse).

The strangest of all creatures which have been dug up out of the earth are the giant monsters of the Reptile Age—the dinosaurs, the ichthyosaurs, etc. (*see* Animals, Prehistoric). Some of these old reptiles were nearly 100 feet long, and some were perhaps the largest animals that ever lived. These illustrate most exactly a law gleaned from the study of fossils—that the farther back we go the smaller do we find the proportion of brain space in the animal's skull. This explains why they died out despite their enormous size and strength, and made way for creatures with more brain and less bulk. The latest of all fossil remains are those of early man, found with the bones of the great animals—the mammoth, the bison, the cave-bear—which he, thanks to his superior brain, was able to kill for food (*see* Cave Dwellers).

Although fossils are found in nearly all countries, the United States and Canada are distinguished for their particularly rich remains of the larger reptiles and mammals. Among the most famous deposits are those of Wyoming, Nebraska, South Dakota, and Colorado. Near Los Angeles, Calif., a very rare type of fossil bed exists, consisting of asphalt deposits, which once were soft and sticky, and probably covered with water. Animals coming to drink were stuck in the asphalt, much as sticky paper catches flies. Great numbers of prehistoric skeletons have been dug out of these dried-up pools in a remarkable state of preservation.

One of the most widely distributed of the fossil families are the trilobites, ancient crablike animals whose horny helmets and back shields are found in ancient rock formations in nearly all parts of the world. Once the prevailing form of animal sea-life, they died out in the changes and biological struggles through which the earth has passed. The king crab of the present day is considered to be possibly the descendant of the trilobite.

Probably the world's greatest collection of fossil reptiles and mammals is found in the American Museum of Natural History in New York. Hundreds of "reconstructions" based on scientific data have been made, which show the strange creatures much as they are believed to have appeared in the world of long ago.

FOX. Bold as it is cunning, this intelligent animal has been celebrated in the folk-tales of all nations as the slyest of the beasts, one of the most noted of these tales being the fascinating medieval epic of Reynard the Fox. Fox-hunting is one of the favorite sports in England, where the animal is carefully preserved for this purpose. In most other countries it is ruthlessly trapped, shot, and poisoned for the sake of the fur and to check its depredations, for the fox is an inveterate poultry thief.

FOXES THAT ARE HUNTED FOR THEIR FUR

The Arctic Fox, on the left, and the Red Fox are both beautiful creatures. But their beauty is their undoing for they are trapped and killed in great numbers for the sake of their sleek coats.

The fox is closely related to the dog and jackal, but distinguished by the sharp muzzle, erect ears, elliptical pupil of the eye and long bushy tail. There are several kinds, common in different parts of the world, with the exception of South America. The one most widely distributed in North America is the red fox, which resembles the common fox of Europe. This animal is about 30 inches in the body and head, and the tail is about one and one-half feet long. Its fur is a reddish-yellow with the tips of the ears and tail black and a white line on the belly.

The Arctic fox which ranges southward to Labrador and Newfoundland has beautiful silky fur, bluish or brown in summer and pure white in winter. The silver fox holds first place among fur-bearers and its skins sell for enormous prices. In this species the hair is jet-black save for the white tips, which give it a hoary or silvered appearance.

All foxes are burrowing animals, though they sometimes make their homes in hollow stumps or holes in rocks. They hide by day and get their food at night. Birds and small animals such as gophers and rabbits are their usual food.

Scientific name of common European red fox is *Vulpes vulpes*. Very similar is the North American species, *Vulpes fulvus*. Of this group the cross fox and black or silver fox are color varieties. The North American gray fox, *Urocyon cinereo-argentatus*, is found from Pennsylvania southward. This variety was once generally distributed over the United States, but has become extinct in the northeastern part.

The OLD "BEAST-EPIC" *of* REYNARD THE FOX

LONG, long ago," as the story-books say, "when animals could talk just like people"—by which, of course, we mean the time when primitive folk were so imaginative that they pictured animals talking and acting like human beings and even gave them names—there first arose this tale which grew into the great beast-epic of 'Reynard the Fox'. In its completed form the poem tells how Reynard—whose name means "strong in counsel" or "keen-witted"—was summoned at different times because of his misdeeds to appear before Noble the Lion, King of the Beasts, to answer charges brought against him by Isengrim the Wolf, Bruin the Bear, Chanticleer the Cock, and other creatures whom he had wronged; and how each time Reynard's sharp wits saved him from punishment.

Once when his uncle Bruin, as the strongest of the beasts, was sent to fetch him into court, Reynard bethought him of a way to escape this bailiff. He complained that he was feeling ill from having eaten of a strange new fare—honeycombs.

"Ha!" cried Bruin. "Honeycombs? Why, it is meat for the greatest emperor in the world. Fair nephew, help me but to some of that honey, and command me whilst I live. For one little part thereof I will be your servant everlastingly."

So Reynard promised to lead his kinsman to a place where he could find as much honey as he could eat. Now the fox had noticed that a certain carpenter had brought into his yard a great hollow oak log, which he had begun to cleave and into which he had struck two wedges in such a way that the cleft stood a great way open. To this log Reynard led Bruin, saying:

"Behold now, dear uncle, within this tree is so much honey that it is immeasurable. Try if you can get into it, good uncle; but eat moderately, for albeit the combs are sweet and good, yet too much is dangerous and may be troublesome to your body."

IS THE HONEY GOOD, UNCLE ?

When greedy Bruin thrust his head into the cleft, Reynard pulled out the wedges, so that the bear was locked fast in the log. Leaving his poor victim struggling in vain to free himself, Reynard started on his homeward way, but stopped to call out mockingly from afar:

"Is the honey good, uncle, which you eat? Eat not too much, I beseech you. Pleasant things are apt to surfeit."

Bruin howled and roared, scratched and tumbled about. He ended by making such a noise that the carpenter came out to see what was the matter, and was followed by all the neighbors. Soon all the parish was there, and Bruin was thrown into a terrible fear by this great army that had come against him. He wrestled and pulled so hard that presently he got his head out; but he left behind him part of his skin, his ears, and his claws. Blood covered his face and paws; he could hardly see or move.

Then all the people added to his torment by beating him with weapons of every sort. The carpenter threw stones; others belabored him with rakes, brooms, distaffs, or whatever they happened to pick up. At last poor Bruin, hardly knowing what he was about, leaped into the river, and by the merest chance escaped with his life.

Reynard, in the meantime, had gone gaily on his way. Many more attempts were made before he was finally brought to trial, and so great was his cunning that even then he escaped the penalties which he richly deserved.

Like the fables of Aesop, 'Reynard the Fox' belongs to a class of animal tales found in the folk-lore of almost all countries. As to the original home of this poem, it has been claimed by both France and Germany. It is now believed to have originated in the borderland between these two countries, far back in medieval times. About the middle of the 12th century a French poet wrote it down in literary form, and a little later a version (probably a translation) appeared in German. Before long it was translated into English and the other chief languages of Europe, becoming one of the most popular of all the stories current in the Middle Ages

HOW TO MASTER FRACTIONS — *Some Simple Methods*

FRACTIONS. If we fold a sheet of paper (Fig. 1A) so as to bring the ends together, the crease made by the folding will divide the paper into two equal parts or *halves*, as in B.

If we open the sheet, spread it out, and fold each end to the middle crease, the paper will be divided by the three creases into four equal parts or *fourths*, (C).

By opening the paper and folding it crosswise so that one side lies upon the other, we shall divide it into *eighths* (D).

By opening the paper and folding each side to the vertical crease, we shall divide it into *sixteenths* (E).

In the last folding the edges have been divided into fourths. By folding the front edge to the first crease and then, after opening the paper, to the third crease, and by folding the back edge to the nearest crease and to the farthest crease, we shall have divided the right and left edges into *eighths.*

These parts—halves, fourths, etc.—are called *fractions*. They are direct relations of quantity and do not depend upon measuring.

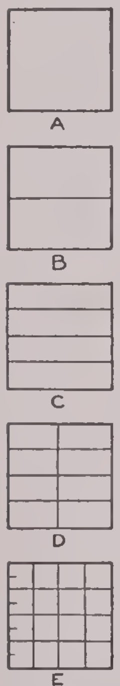


Fig. 1

Halves

1. How many halves in 1? (*See* Fig. 1B.)

2. What is $\frac{1}{2}$ of 3? $\frac{1}{2}$ of 5? $\frac{1}{2}$ of 7? $\frac{1}{2}$ of 9? Draw lines 3 inches long, 5 inches long, etc. Divide each in half and measure.

3. Add:

$$\begin{array}{cccccc} 2\frac{1}{2} & 3\frac{1}{2} & 4\frac{1}{2} & 3\frac{1}{2} & 6\frac{1}{2} & 6 \\ \underline{2\frac{1}{2}} & \underline{3\frac{1}{2}} & \underline{4\frac{1}{2}} & \underline{4\frac{1}{2}} & \underline{7\frac{1}{2}} & \underline{5\frac{1}{2}} \end{array}$$

4. Subtract:

$$\begin{array}{cccccc} 7 & 9 & 8 & 12 & 9\frac{1}{2} & 18\frac{1}{2} \\ \underline{3\frac{1}{2}} & \underline{4\frac{1}{2}} & \underline{3\frac{1}{2}} & \underline{4\frac{1}{2}} & \underline{2\frac{1}{2}} & \underline{7\frac{1}{2}} \end{array}$$

To solve $7-3\frac{1}{2}$, draw a line 7 inches long. Cut off $3\frac{1}{2}$ inches. How much is left?

Fourths

Cut out pieces of paper like those shown in Fig. 2: (a) 4 inches square; (b) 2 inches by 4 inches; (c) 2 inches by 2 inches; (d) irregular form 4 inches by 4 inches on the long sides; (e) 4 inches square, creased into fourths. Write the fraction name on each form.

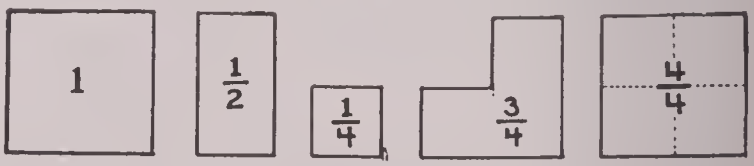


Fig. 2

1. Compare $\frac{1}{2}$ with two of the $\frac{1}{4}$ forms put end to end; $\frac{3}{4}$ with three of the $\frac{1}{4}$ forms; 1 with $\frac{4}{4}$.

2. Study the picture problems in Fig. 3. Place $\frac{1}{4}$ and $\frac{1}{2}$ together. Which fraction could be covered by their sum? Place $\frac{1}{4}$ and $\frac{3}{4}$ together. Which form does their sum equal? Place two of the $\frac{3}{4}$ forms together. What fraction must be added to 1 to equal their sum?

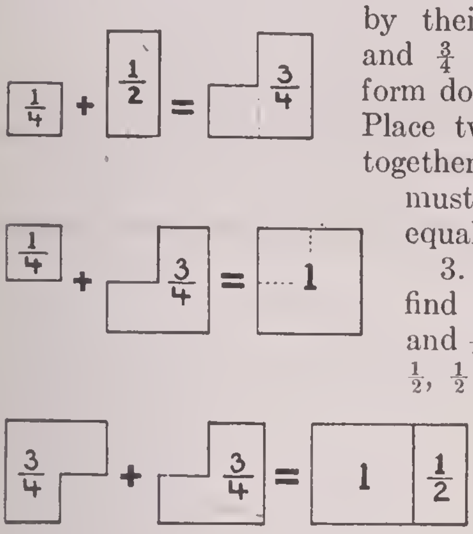


Fig. 3

3. In the same way, find other sums, as $\frac{1}{2}$ and $\frac{3}{4}$, $\frac{1}{4}$ and $\frac{1}{4}$, $\frac{1}{2}$ and $\frac{1}{2}$, $\frac{1}{2}$ and $\frac{1}{4}$ and $\frac{1}{4}$.

4. Add:
$1\frac{1}{4}$ and $1\frac{1}{2}$
$3\frac{3}{4}$ and $2\frac{3}{4}$
$2\frac{3}{4}$ and $2\frac{1}{4}$
$1\frac{1}{2}$ and $2\frac{3}{4}$

5. Add:	$8\frac{1}{4}$	$4\frac{1}{4}$	$7\frac{1}{4}$	$3\frac{1}{2}$	$6\frac{3}{4}$	5	$6\frac{1}{4}$
	$6\frac{1}{2}$	$3\frac{1}{4}$	$2\frac{3}{4}$	$2\frac{1}{4}$	$5\frac{1}{4}$	$8\frac{1}{4}$	9
	$7\frac{1}{2}$	$3\frac{3}{4}$	$8\frac{3}{4}$	$6\frac{3}{4}$	8	$7\frac{3}{4}$	12
	$3\frac{3}{4}$	$3\frac{3}{4}$	$2\frac{3}{4}$	$7\frac{1}{2}$	$3\frac{3}{4}$	5	$15\frac{3}{4}$

6. Place $\frac{3}{4}$ on 1. Which other unit added to $\frac{3}{4}$ will cover the 1? Then $1 - \frac{3}{4} =$ what?

7. Place $\frac{1}{4}$ on 1. How much added to $\frac{1}{4}$ will equal 1? Then $1 - \frac{1}{4} =$ what?

8. Similarly find $\frac{3}{4} - \frac{1}{4}$; $\frac{3}{4} - \frac{1}{2}$.

9. Subtract:	$7\frac{1}{2}$	$13\frac{3}{4}$	6	$8\frac{1}{4}$	$6\frac{3}{4}$	10
	$6\frac{1}{4}$	$4\frac{1}{4}$	$2\frac{1}{4}$	$2\frac{1}{4}$	$2\frac{1}{2}$	$3\frac{3}{4}$

Draw a line $7\frac{1}{2}$ inches long. Cut off $6\frac{1}{4}$ inches. How much is left? Measure.

10. Place $\frac{1}{4}$ with 1 so as to make $1\frac{1}{4}$. Find two fractions whose sum equals $1\frac{1}{4}$; also $1\frac{1}{2}$.

11. Subtract:	$6\frac{1}{4}$	$9\frac{1}{4}$	$7\frac{1}{2}$	12	$7\frac{1}{2}$	$12\frac{3}{4}$
	$3\frac{1}{2}$	$3\frac{3}{4}$	$3\frac{3}{4}$	$3\frac{3}{4}$	$6\frac{3}{4}$	6

Prove the results by drawing lines and cutting off the subtracted part, then measuring the remainder.

Eighths

Cut pieces of paper like the shapes in Fig. 4. Let the 1 be 4 inches by 4 inches, the $\frac{1}{2}$, 2 inches by 4, etc.

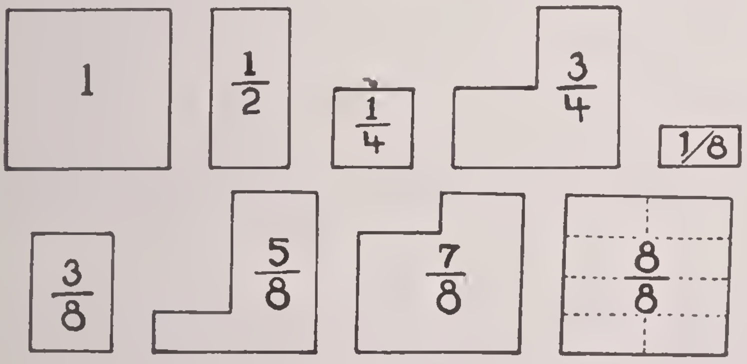


Fig. 4

Make sums and differences as in the exercises with fourths.

1. Which fraction equals $\frac{4}{8}$? Which one equals $\frac{2}{8}$? Which equals $\frac{6}{8}$? Changing $\frac{4}{8}$ to $\frac{1}{2}$ or $\frac{6}{8}$ to $\frac{3}{4}$ is called *reducing to lowest terms.*

2. Place $\frac{1}{8}$ with each of the other forms to find sums.

3. Add:	$4\frac{1}{8}$	$7\frac{1}{8}$	$2\frac{1}{8}$	$9\frac{1}{8}$	$6\frac{1}{8}$	$5\frac{1}{8}$	$7\frac{7}{8}$	$4\frac{1}{8}$
	$2\frac{1}{8}$	$3\frac{1}{4}$	$5\frac{3}{8}$	$5\frac{1}{2}$	$3\frac{5}{8}$	$6\frac{3}{4}$	$3\frac{1}{8}$	8

Verify the results by drawing lines $4\frac{1}{8}$ inches and $2\frac{1}{8}$ inches long, end to end, and measuring; and so with the remaining examples.

4. Add:	$2\frac{1}{4}$	7	$6\frac{1}{8}$	$5\frac{3}{4}$	$4\frac{1}{4}$	$6\frac{1}{2}$	$7\frac{5}{8}$	$6\frac{1}{4}$
	$3\frac{3}{8}$	$3\frac{1}{8}$	$2\frac{1}{8}$	$8\frac{1}{8}$	$2\frac{5}{8}$	$5\frac{1}{8}$	$4\frac{1}{8}$	$7\frac{7}{8}$

Verify the results as before.

5. Add:	$3\frac{3}{8}$	$4\frac{3}{8}$	$3\frac{3}{8}$	$5\frac{3}{8}$	$7\frac{3}{8}$	$6\frac{3}{8}$	$8\frac{7}{8}$	$8\frac{3}{8}$
	$2\frac{3}{8}$	$2\frac{1}{2}$	$8\frac{1}{4}$	6	$5\frac{5}{8}$	$3\frac{3}{4}$	$6\frac{1}{4}$	$2\frac{7}{8}$

In solving $6\frac{3}{8} + 3\frac{3}{4}$, notice that $\frac{6}{8} + \frac{3}{8} = \frac{9}{8}$; but $\frac{9}{8}$ is greater than 1 or $\frac{8}{8}$. Therefore $\frac{9}{8} = 1\frac{1}{8}$. Changing $\frac{9}{8}$ to $1\frac{1}{8}$ is called *reducing the improper fraction* $\frac{9}{8}$ to a *mixed number* ($1\frac{1}{8}$). In solving $8\frac{3}{8} + 2\frac{7}{8}$ notice that $\frac{10}{8} = \frac{5}{4} = 1\frac{1}{4}$.

6. Subtract:	$11\frac{1}{4}$	$12\frac{3}{8}$	$12\frac{1}{2}$	$5\frac{5}{8}$	$9\frac{3}{4}$	$7\frac{7}{8}$	13
	$3\frac{1}{8}$	$5\frac{1}{8}$	$4\frac{1}{8}$	$3\frac{1}{8}$	$4\frac{1}{8}$	$3\frac{1}{8}$	$9\frac{1}{8}$

Verify the last two by drawing lines $7\frac{7}{8}$ inches and 13 inches long and cutting off the measurements as indicated.

7. Which fraction is contained 6 times in $\frac{3}{4}$? Use the different forms in Fig. 4 and measure. Which is contained 3 times in $\frac{3}{4}$?

8. Fill the blanks:

$\frac{1}{6}$ of $\frac{3}{4} =$	$6 \times \quad = \frac{3}{4}$	$\frac{1}{2}$ of $\frac{3}{4} =$
$\frac{1}{3}$ of $\frac{3}{4} =$	$3 \times \quad = \frac{3}{4}$	$\frac{2}{3}$ of $\frac{3}{4} =$
$\frac{3}{4} \div 6 =$	$\frac{3}{4} \div \frac{1}{8} =$	$\frac{5}{6}$ of $\frac{3}{4} =$

9. Which form equals $\frac{2}{3}$ of $\frac{3}{4}$? Find one that covers $\frac{2}{3}$ of $\frac{3}{4}$. Then $\frac{2}{3} \times \frac{3}{4} =$? (Read the sign × as "of.")

10. Which form of Fig. 4 is contained 5 times in $\frac{5}{8}$? Then $\frac{5}{8} \div 5 =$?

11. Find $\frac{1}{7} \times$ (of) $\frac{7}{8}$; $\frac{2}{7} \times \frac{7}{8}$; $\frac{3}{7} \times \frac{7}{8}$; $\frac{4}{7} \times \frac{7}{8}$. (Find forms to cover $\frac{1}{7}$, $\frac{2}{7}$, $\frac{3}{7}$, $\frac{4}{7}$, etc., of $\frac{7}{8}$.)

12. Add:	$3\frac{5}{8}$	$4\frac{5}{8}$	$5\frac{5}{8}$	$2\frac{5}{8}$	$9\frac{3}{4}$
	$7\frac{1}{2}$	$2\frac{5}{8}$	$6\frac{3}{4}$	$3\frac{7}{8}$	$7\frac{7}{8}$

In solving these problems notice that: $\frac{10}{8} = \frac{5}{4}$; $\frac{11}{8} = 1\frac{3}{8}$; $\frac{12}{8} = \frac{3}{2} = 1\frac{1}{2}$.

Thirds

Cut forms of paper like those in Fig. 5. Let the $\frac{3}{3}$ be 3 inches square. Write the fraction names upon the forms.

Add:	$3\frac{1}{3}$	$6\frac{2}{3}$	7	$6\frac{2}{3}$	8
	$3\frac{1}{3}$	$3\frac{1}{3}$	$5\frac{1}{3}$	$6\frac{2}{3}$	$4\frac{2}{3}$
Subtract:	$6\frac{2}{3}$	$7\frac{1}{3}$	8	8	$4\frac{1}{3}$
	$2\frac{1}{3}$	6	$2\frac{1}{3}$	$2\frac{2}{3}$	$2\frac{2}{3}$

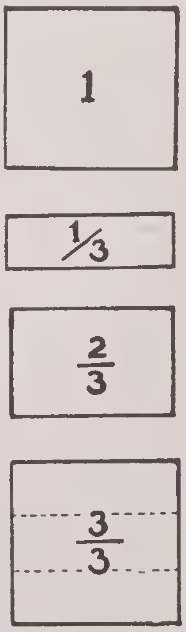


Fig. 5

To solve 8 minus $2\frac{1}{3}$ use the *additive method* (like making change). Think $\frac{2}{3}$ added to $2\frac{1}{3}$ makes 3, and 5 more makes 8. We added $5\frac{2}{3}$, so 8 minus $2\frac{1}{3} = 5\frac{2}{3}$. To solve $4\frac{1}{3} - 2\frac{2}{3}$, think how much must be added to $2\frac{2}{3}$ to make $4\frac{1}{3}$. Thus $\frac{1}{3}$ more makes 3, 1 more makes 4, and $\frac{1}{3}$ more makes $4\frac{1}{3}$. We added $1\frac{2}{3}$, so $4\frac{1}{2} - 2\frac{2}{3} = 1\frac{2}{3}$.

Sixths

Cut forms as in Fig. 6, making the $\frac{6}{6}$ either 3 inches or 6 inches square. Write the fraction names upon the forms.

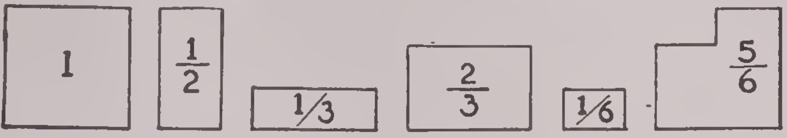


Fig. 6

1. Make sums by placing any two forms together. *Example:* $\frac{2}{3} + \frac{1}{6} = \frac{5}{6}$.

2. Observe the forms and answer: What fraction equals $\frac{2}{6}$? $\frac{3}{6}$? $\frac{4}{6}$?

3. Place $\frac{1}{3}$ on $\frac{2}{3}$ and tell what part of the $\frac{2}{3}$ is covered. What part of $\frac{2}{3} = \frac{1}{3}$?

4. Show that $\frac{2}{3} \div \frac{1}{3} = 2$; $\frac{2}{3} \div \frac{1}{6} = 4$; $\frac{1}{2} \div \frac{1}{6} = 3$.

5. Show $\frac{1}{6} + \frac{1}{6}$ and give the sum; $\frac{1}{6} + \frac{1}{3}$; $\frac{1}{6} + \frac{1}{2}$; $\frac{1}{3} + \frac{2}{3}$; $\frac{1}{6} + \frac{5}{6}$.

6. Change $\frac{2}{6}$, $\frac{4}{6}$, $\frac{3}{6}$ to lowest terms.

7. Add:

$$\begin{array}{ccccccc} 5\frac{1}{6} & 3\frac{1}{3} & 8\frac{1}{2} & 6\frac{2}{3} & 5\frac{5}{6} & 8 & 9 \\ \underline{4\frac{1}{6}} & \underline{2\frac{1}{6}} & \underline{3\frac{1}{6}} & \underline{5\frac{1}{6}} & \underline{4\frac{1}{6}} & \underline{3\frac{1}{6}} & \underline{4\frac{5}{6}} \end{array}$$

8. Lay the form $\frac{1}{6}$ on the form $\frac{1}{3}$; on $\frac{1}{2}$; on $\frac{2}{3}$; on $\frac{5}{6}$. How many sixths remain uncovered in each case? Change the remainder to lowest terms in each case.

9. Subtract:

$$\begin{array}{cccccc} 5\frac{1}{6} & 13\frac{1}{3} & 18\frac{1}{2} & 16\frac{2}{3} & 15\frac{5}{6} & 16 \\ \underline{4\frac{1}{6}} & \underline{12\frac{1}{6}} & \underline{13\frac{1}{6}} & \underline{12\frac{1}{6}} & \underline{11\frac{1}{6}} & \underline{12\frac{1}{6}} \end{array}$$

10. Lay the form $\frac{1}{3}$ on the form $\frac{1}{2}$; $\frac{1}{2}$ on $\frac{2}{3}$; $\frac{2}{3}$ on $\frac{5}{6}$; $\frac{5}{6}$ on 1. How many sixths are left uncovered in each case?

11. Subtract:

$$\begin{array}{cccccc} 7\frac{1}{2} & 6\frac{2}{3} & 15\frac{5}{6} & 8\frac{5}{6} & 6\frac{5}{6} & 12 \\ \underline{3\frac{1}{3}} & \underline{4\frac{1}{2}} & \underline{6\frac{2}{3}} & \underline{2\frac{1}{3}} & \underline{2\frac{1}{2}} & \underline{5\frac{5}{6}} \end{array}$$

12. Show $\frac{1}{3} + \frac{1}{2}$; $\frac{1}{3} + \frac{5}{6}$; $\frac{1}{2} + \frac{2}{3}$; $\frac{1}{2} + \frac{5}{6}$: $\frac{2}{3} + \frac{5}{6}$. Reduce $\frac{7}{6}$ to a mixed number. Reduce $\frac{8}{6}$ and $\frac{9}{6}$ to lowest terms and then to mixed numbers.

13. Add:

$$\begin{array}{ccccccc} 3\frac{1}{3} & 8\frac{1}{3} & 7\frac{1}{2} & 4\frac{1}{2} & 16\frac{2}{3} & 5\frac{5}{6} & 7\frac{5}{6} \\ \underline{2\frac{1}{2}} & \underline{5\frac{5}{6}} & \underline{6\frac{2}{3}} & \underline{5\frac{5}{6}} & \underline{2\frac{5}{6}} & \underline{6\frac{2}{3}} & \underline{6\frac{5}{6}} \end{array}$$

14. Show $\frac{5}{6} - \frac{1}{3}$ by laying the form $\frac{1}{3}$ on the form $\frac{5}{6}$. Which form equals the uncovered part of the $\frac{5}{6}$?

15. In the same way show $\frac{5}{6} - \frac{1}{2}$; $1\frac{1}{6} - \frac{5}{6}$; $1\frac{1}{6} - \frac{1}{3}$.

16. Show $1\frac{1}{3} - \frac{1}{2}$; $1\frac{1}{3} - \frac{2}{3}$; $1\frac{1}{2} - \frac{5}{6}$; $1\frac{1}{2} - \frac{2}{3}$.

17. Subtract:

$$\begin{array}{cccccc} 5\frac{5}{6} & 14\frac{5}{6} & 11\frac{1}{6} & 7\frac{1}{2} & 7\frac{1}{2} & 9\frac{1}{6} \\ \underline{3\frac{1}{3}} & \underline{12\frac{1}{2}} & \underline{8\frac{1}{3}} & \underline{2\frac{5}{6}} & \underline{6\frac{2}{3}} & \underline{5\frac{5}{6}} \end{array}$$

Solution of last: $9\frac{1}{6}$
$\underline{5\frac{5}{6}}$
Add $\frac{1}{6}$ to make the subtrahend 6
Add 3 to make the subtrahend 9
Add $\frac{1}{6}$ to make the subtrahend $9\frac{1}{6}$
Answer: $3\frac{1}{3}$ total of parts added.

18. Which unit equals $\frac{1}{2}$ of $\frac{1}{3}$? $\frac{1}{4}$ of $\frac{2}{3}$? $\frac{3}{4}$ of $\frac{2}{3}$? $\frac{1}{3}\times\frac{1}{2}$? $\frac{1}{2}\times\frac{2}{3}$? $4\times\frac{1}{6}$? $\frac{3}{4}\times\frac{5}{6}$? Show by comparing forms. (Say "$\frac{1}{2}$ *of* $\frac{2}{3}$," but "4 *times* $\frac{1}{6}$.")

19. Lay the form $\frac{1}{6}$ on the form $\frac{2}{3}$ to find out how many times $\frac{2}{3}$ contains $\frac{1}{6}$. Then $\frac{2}{3} \div \frac{1}{6} = 4$. $\frac{5}{6} \div \frac{1}{6} = ?$ $\frac{1}{2} \div \frac{1}{6} = ?$ $\frac{1}{3} \div \frac{1}{6} = ?$ Show.

20. Compare $\frac{1}{2}$ with $\frac{1}{3}$.
Solution: Using the form $\frac{1}{6}$ for a measure, we find it contained 3 times in $\frac{1}{2}$. We also find $\frac{1}{6}$ is $\frac{1}{2}$ as large as $\frac{1}{3}$. So $\frac{1}{2}$ is 3 times $\frac{1}{2}$ of $\frac{1}{3} = \frac{3}{2}$ of $\frac{1}{3}$.

21. Compare $\frac{1}{3}$ with $\frac{1}{2}$.
Solution: $\frac{1}{3}$ contains $\frac{1}{6}$ 2 times. But $\frac{1}{6} = \frac{1}{3}$ of $\frac{1}{2}$. (Show this.) So $\frac{1}{3}$ is $\frac{2}{3}$ of $\frac{1}{2}$.

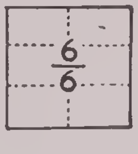
22. Compare $\frac{1}{2}$ with $\frac{2}{3}$. Use $\frac{1}{6}$ to measure $\frac{1}{2}$. $\frac{1}{6} = \frac{1}{4}$ of $\frac{2}{3}$. (Show this by measuring $\frac{2}{3}$ with $\frac{1}{6}$ as a measure.) So $\frac{1}{2} = 3$ times $\frac{1}{4}$ of $\frac{2}{3}$, or $\frac{3}{4}$ of $\frac{2}{3}$.

23. $\frac{1}{2} =$ what part of $\frac{2}{3}$? In the last problem $\frac{1}{2} = \frac{3}{4}\times\frac{2}{3}$, but since measure is expressed by division, $\frac{1}{2} \div \frac{2}{3} = \frac{3}{4}$ ($\frac{1}{2}$ compared with or divided by $\frac{2}{3}$ gives $\frac{3}{4}$ as a quotient).

24. $\frac{2}{3} \div \frac{5}{6} =$ what?
Solution: This means: $\frac{2}{3}$ is what part of $\frac{5}{6}$? Using $\frac{1}{6}$ as a measure, $\frac{2}{3}$ is found to be 4 times as great as $\frac{1}{6}$. But $\frac{1}{6}$ is $\frac{1}{5}$ as great as $\frac{5}{6}$. So $\frac{2}{3}$ is 4 times as much as $\frac{1}{5}$ of $\frac{5}{6}$, or $\frac{4}{5}$ of $\frac{5}{6}$. Therefore, $\frac{2}{3} \div \frac{5}{6} = \frac{4}{5}$.

Twelfths

1. Cut a form one-half as large as $\frac{1}{6}$. How many such units does 1 contain? Call it $\frac{1}{12}$. $\frac{1}{2}$ of $\frac{1}{6} = \frac{1}{12}$.



2. Measure the form $\frac{1}{2}$, using the form $\frac{1}{12}$ as a measure. $\frac{1}{2} =$ how many twelfths?

3. In the same way change $\frac{1}{3}$ to twelfths. Change $\frac{5}{6}$ to twelfths. Lay form $\frac{5}{6}$ on form $\frac{12}{12}$.

4. Make a form 3 times as large as $\frac{1}{12}$. Apply this $\frac{3}{12}$ to the 1. $\frac{3}{12} = \frac{1}{\text{what}}$? $\frac{9}{12} = \frac{3}{\text{what}}$?

5. In the same way reduce $\frac{6}{12}$, $\frac{4}{12}$, $\frac{8}{12}$, and $\frac{10}{12}$ to their lowest terms.

6. Reduce $\frac{3}{12}$ and $\frac{9}{12}$ to lowest terms. How can $\frac{8}{10}$ be reduced to lowest terms? $\frac{6}{9}$? $\frac{12}{15}$? $\frac{15}{20}$?

Rule. To reduce a fraction to its lowest terms divide its numerator (the mumber above the line) and denominator (the number below the line) by the same number. Do it again and again if necessary until no number will exactly divide both.

7. Change $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{3}$, $\frac{1}{6}$, $\frac{5}{6}$, $\frac{3}{4}$, $\frac{2}{3}$ to twelfths.

8. Write $\frac{1}{12}$, $\frac{2}{12}$, $\frac{3}{12}$, $\frac{4}{12}$, etc., in order, to $\frac{12}{12}$, changing each fraction that can be so reduced, to its lowest terms.

9. Add $\frac{2}{3}$ and $\frac{3}{4}$.
Solution: To solve $\frac{1}{2} + \frac{1}{3}$, $\frac{1}{2} - \frac{1}{3}$, $\frac{2}{3} + \frac{1}{2}$, or $\frac{2}{3} - \frac{1}{2}$ it was found necessary to change the fractions to sixths. Likewise we cannot add thirds and fourths any more than we can add pecks and quarts, unless they are reduced to fractions of like denomination, that is, having the same denominator. We can add $\frac{1}{4}$ and $\frac{3}{4}$ or $\frac{1}{6}$ and $\frac{5}{6}$ or $\frac{2}{7}$ and $\frac{3}{7}$ because they are like in kind or of same denomination (have same denominator). Now, how can we reduce $\frac{2}{3}$ and $\frac{3}{4}$ to other fractions of the same value as $\frac{2}{3}$ and $\frac{3}{4}$ but having the same denominator? Consult Problem 7 above. $\frac{2}{3} = \frac{8}{12}$ and $\frac{3}{4} = \frac{9}{12}$. So $\frac{2}{3} + \frac{3}{4} = \frac{8}{12} + \frac{9}{12} = \frac{17}{12} = 1\frac{5}{12}$.

10. Subtract $\frac{3}{4}$ from $\frac{5}{6}$.
Solution: By reference to Problem 7 above, we see that fourths and sixths can be changed to twelfths. So $\frac{5}{6} - \frac{3}{4} = \frac{10}{12} - \frac{9}{12} = \frac{1}{12}$. 12 is said to be the *common denominator*, and twelfths the *common denomination.*

Common Denominators

1. Add $\frac{1}{2}$ and $\frac{3}{5}$.
Solution: Evidently $\frac{1}{2}$ and $\frac{3}{5}$ cannot be added until they are reduced to a common denomination. The unit or 1 thought of here must divide into 2 parts to show halves and into 5 parts to show fifths. For convenience draw a form 5 inches long and 2 inches wide. Divide it into halves by a horizontal line and into fifths by vertical lines. Each small division of this form must be $\frac{1}{10}$. Why? So tenths is the denomination we seek. $\frac{1}{2} + \frac{3}{5} = \frac{5}{10} + \frac{6}{10} = \frac{11}{10} = 1\frac{1}{10}$. 10 is the common denominator.

2. To what common denomination can we change thirds and fifths? fourths and fifths? halves and sevenths? thirds and sevenths? thirds and eighths?

3. Add $\frac{5}{6}$ and $\frac{3}{4}$.
Solution: In the figure below (Fig. 7) we see that if we measure a 24-inch line with a 6-inch ruler, we say 6, 12, 18, 24; if we measure it with a 4-inch ruler, we say 4, 8, 12, 16, 20, 24. 12, 18, and 24 are *multiples* of 6; 8, 12, 16, 20, 24 are multiples of 4. We notice that 24 is found in both sets of multiples. It is therefore a *common multiple* of 4 and 6. But we notice that 12 is also a common multiple of 4 and 6 and since it is the smallest possible common multiple of 4 and 6, it is called the *least common multiple* of 4 and 6. 12 is the *least common denominator* desired and twelfths the *least common denomination* of fourths and sixths.

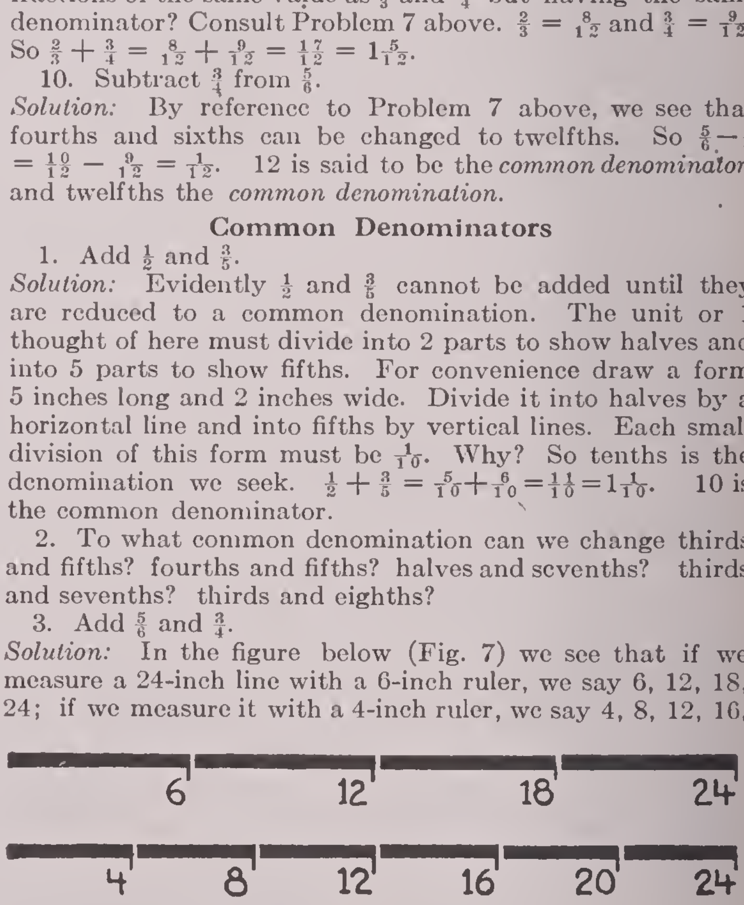


Fig. 7

Hence $\frac{5}{6} + \frac{3}{4} = \frac{10}{12} + \frac{9}{12} = \frac{19}{12} = 1\frac{7}{12}$.
($\frac{1}{6} = \frac{2}{12}$; $\frac{5}{6} = \frac{10}{12}$. $\frac{1}{4} = \frac{3}{12}$; $\frac{3}{4} = \frac{9}{12}$.)

4. Subtract $\frac{4}{9}$ from $\frac{5}{6}$.

Solution: 9, 18, 27, 36, 45, 54, multiples of 9.
6, 12, 18, 24, 30, 36, 42, 48, 54, multiples of 6.
6×9 = 54, a common multiple of 6 and 9.
But 18 and 36 are also common multiples of 6 and 9.
Hence 18 is the *least* common multiple wanted.
($\frac{1}{9} = \frac{2}{18}$; $\frac{4}{9} = \frac{8}{18}$. $\frac{1}{6} = \frac{3}{18}$; $\frac{5}{6} = \frac{15}{18}$.)
$\frac{5}{6} - \frac{4}{9} = \frac{15}{18} - \frac{8}{18} = \frac{7}{18}$.

5. Subtract $\frac{3}{8}$ from $\frac{5}{12}$.

Hints: What is the largest number that will exactly divide 8 and 12? 8×12 ÷ 4 = what?

6. Reduce to a common denomination: $\frac{2}{3}$, $\frac{5}{6}$, $\frac{1}{2}$.

Hint: 6 is a multiple of 2 and also of 3.

7. Find the common denominator of $\frac{2}{3}$, $\frac{7}{12}$, $\frac{3}{4}$, $\frac{1}{2}$, $\frac{5}{6}$.

Hint: What is the smallest number the given denominators will all divide?

8. Find the common denominator of $\frac{1}{8}$, $\frac{1}{12}$, $\frac{1}{16}$, $\frac{1}{3}$.

Hint: Notice that 8 will exactly divide 16 and 3 will exactly divide 12. What is the least number 12 and 16 will exactly divide?

Reducing a Mixed Number to an Improper Fraction

Example: $8\frac{4}{5}$ = what?

Solution: (a) $1 = \frac{5}{5}$.
(b) $8 = 8 \times \frac{5}{5} = \frac{40}{5}$.
(c) $8\frac{4}{5} = 8 \times \frac{5}{5} + \frac{4}{5} = \frac{44}{5}$.

Reducing an Improper Fraction to a Mixed Number

Example: $\frac{44}{5}$ = what?

Solution: $\frac{44}{5} = 44 \div 5 = 8\frac{4}{5}$.

Multiplication

1. $8\times\frac{3}{5}$ (8 times 3 fifths) = what?

Solution: $8\times\frac{3}{5} = \frac{24}{5} = 4\frac{4}{5}$. (Multiply the numerator. Keep the denominator the same.)

2. $\frac{3}{5}\times8$ ($\frac{3}{5}$ of 8) = what?

Solution: $\frac{3}{5}$ of $8 = 8\times\frac{3}{5} = \frac{24}{5} = 4\frac{4}{5}$.

3. $4\frac{2}{3}\times6\frac{1}{5}$ ($4\frac{2}{3}$ times $6\frac{1}{5}$) = what?

Solution: $4\frac{2}{3}\times6\frac{1}{5} = \frac{14}{3}\times\frac{31}{5} = \frac{434}{15} = 28\frac{14}{15}$.

4. Find $\frac{3}{4}\times\frac{2}{5}$ (three-fourths of two-fifths).

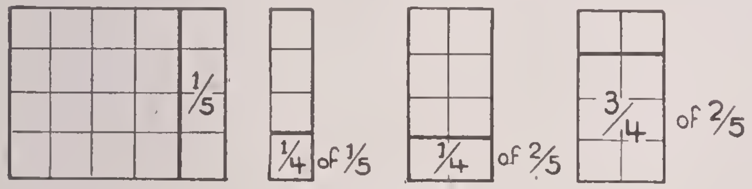


Fig. 8

Solution: Divide a unit (1) into fifths by vertical lines, and fourths by horizontal lines (Fig. 8). Show $\frac{1}{5}$. Divide into 4 equal parts. Show $\frac{1}{4}$ of $\frac{1}{5}$. How many parts each equal to $\frac{1}{4}$ of $\frac{1}{5}$ in a whole 1?
(a) $\frac{1}{4}\times\frac{1}{5} = \frac{1}{20}$ ($\frac{1}{4}$ of $\frac{1}{5}$).
(b) $\frac{1}{4}\times\frac{2}{5} = \frac{2}{20}$.
(c) $\frac{3}{4}\times\frac{2}{5} = \frac{6}{20} = \frac{3}{10}$.
(d) $\frac{3}{\underset{2}{\cancel{4}}}\times\frac{\overset{1}{\cancel{2}}}{5}=\frac{3}{10}$.

(Canceling the common factor 2 in both numerator and denominator brings the result in its lowest terms.)

5. Find $\frac{2}{3} \times \frac{3}{4}$.

Solution: $\frac{2}{3} \times \frac{3}{4} = \frac{6}{12} = \frac{1}{2}$.

or: $\frac{\cancel{2}}{\underset{1}{\cancel{3}}}\times\frac{\overset{1}{\cancel{3}}}{\underset{2}{\cancel{4}}}=\frac{1}{2}$.

(By canceling the common factors 3 and 2 we can save a step and obtain a result in its lowest terms.)

6. Find $2\frac{2}{3}\times6\frac{1}{4}$ ($2\frac{2}{3}$ times $6\frac{1}{4}$).

Solution: $2\frac{2}{3}\times6\frac{1}{4}=\frac{\overset{2}{\cancel{8}}}{3}\times\frac{25}{\cancel{4}}=\frac{50}{3}=16\frac{2}{3}$.

Division

1. Divide 5 by $\frac{1}{4}$.

Solution: (a) $1 \div \frac{1}{4} = 4$. ($4 \times \frac{1}{4} = 1$.)
(b) $5 \div \frac{1}{4} = 5 \times 4 = 20$. (In 5, $\frac{1}{4}$ is contained 5 times as often as in 1.)

2. Divide 7 by $\frac{1}{3}$; 8 by $\frac{1}{5}$; 16 by $\frac{1}{9}$.

3. Divide 5 by $\frac{3}{4}$.

Solution: (a) $5 \div \frac{1}{4} = 20$.
(b) $5 \div \frac{3}{4} = \frac{1}{3}$ of $20 = 6\frac{2}{3}$. ($\frac{3}{4}$ is contained in any number $\frac{1}{3}$ as often as $\frac{1}{4}$ is, because it is 3 times as large.)

or: (a) $5 \div 1 = 5$.
(b) $5 \div \frac{1}{4} = 4\times5$. ($\frac{1}{4}$ is contained in any number 4 times as often as 1 is.)
(c) $5 \div \frac{3}{4} = \frac{1}{3}$ of $4 \times 5 = \frac{20}{3} = 6\frac{2}{3}$.

4. $8 \div \frac{4}{5}$ = what?

Solution: $8 \div 1 = 8$.
$8 \div \frac{1}{5} = 5\times8$. (why?)
$8\div\frac{4}{5}=\frac{1}{4}$ of $5\times8=\frac{5}{\cancel{4}}\times\overset{2}{\cancel{8}}=10$.

Answer: $\frac{4}{5}$ is contained in 8 ten times.

Proof: $\overset{2}{\cancel{10}}\times\frac{4}{\cancel{5}}=8$.

5. $9 \div \frac{1}{6}$ = ?

Solution: $9 \div \frac{1}{6} = 6\times9 = 54$. ($\frac{1}{6}$ is contained in any number 6 times as often as 1 is.)

6. $9 \div \frac{5}{6}$ = what?

Solution: (a) $9 \div \frac{1}{6} = 6 \times 9$.
(b) $9 \div \frac{5}{6} = \frac{1}{5}$ of $6 \times 9 = \frac{6}{5}$ of $9 = \frac{54}{5} = 10\frac{4}{5}$.
($\frac{5}{6}$ is contained in any number $\frac{1}{5}$ as often as $\frac{1}{6}$ is.)

7. $\frac{3}{4} \div \frac{1}{3}$ = what?

Solution: $\frac{3}{4} \div \frac{1}{3} = 3\times\frac{3}{4} = \frac{9}{4} = 2\frac{1}{4}$.
($\frac{1}{3}$ is contained in any fraction or number 3 times as often as 1 is. 1 is contained in $\frac{3}{4}$, $\frac{3}{4}$ of a time, so $\frac{1}{3}$ is contained in $\frac{3}{4}$, $3\times\frac{3}{4}$ times.)

8. $\frac{3}{4} \div \frac{2}{3}$ = what?

Solution: $\frac{3}{4} \div \frac{2}{3} = \frac{3}{2} \times \frac{3}{4} = \frac{9}{8} = 1\frac{1}{8}$ (because $\frac{2}{3}$ is contained $\frac{1}{2}$ as often as $\frac{1}{3}$).

9. $6\frac{3}{4} \div 2\frac{1}{4}$ = what?

Solution: $6\frac{3}{4}\div2\frac{1}{4}=\frac{27}{4}\div\frac{9}{4}=\frac{\cancel{4}}{\cancel{9}}\times\frac{\overset{3}{\cancel{27}}}{\cancel{4}}=3$.

Thus we see that division of fractions is accomplished by inverting the divisor and multiplying.

Adding Mixed Numbers

In adding mixed numbers, expand the fractions to a common denominator, add them, then add the sum of the fractions to the sum of the integers.

Example: $12\,\frac{2}{3} + 21\,\frac{3}{4} + 8\,\frac{1}{2}$.

Form in Full

$$\begin{array}{rcl} 12\,\frac{2}{3} & = & 12\,\frac{8}{12} \\ 21\,\frac{3}{4} & = & 21\,\frac{9}{12} \\ 8\,\frac{1}{2} & = & 8\,\frac{6}{12} \\ \hline \end{array}$$
$$41\,\frac{23}{12} = 41 + 1\,\frac{11}{12} = 42\,\frac{11}{12}.$$

Short Form

$$\begin{array}{r|l} 12\,\frac{2}{3} & 8 \\ 21\,\frac{3}{4} & 9 \\ 8\,\frac{1}{2} & 6 \\ \hline 42\,\frac{11}{12} & \frac{23}{12} = 1\,\frac{11}{12}. \end{array}$$

Subtracting Mixed Numbers

Example: $24\frac{1}{3} - 10\frac{3}{4}$.

$$\begin{array}{rl} 24\,\frac{1}{3} & \\ 10\,\frac{3}{4} & \\ \hline \frac{1}{4} & \text{(add } \frac{1}{4} \text{ to make the subtrahend 11).} \\ 13 & \text{(add 13 to make the subtrahend 24).} \\ \frac{1}{3} & \text{(add } \frac{1}{3} \text{ to make the subtrahend } 24\frac{1}{3}\text{).} \\ \hline 13\,\frac{7}{12} & \text{total added.} \end{array}$$

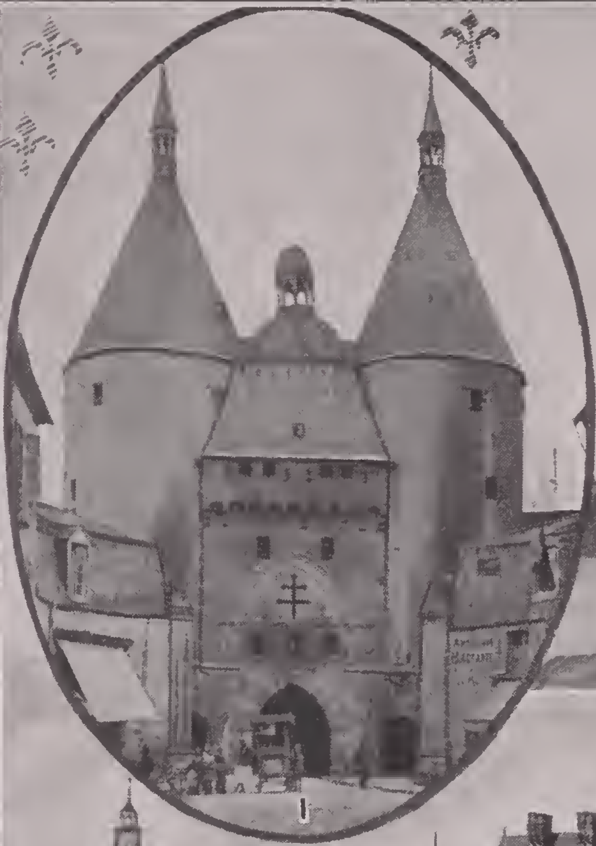
Multiplying Mixed Numbers

To multiply a mixed number by an integer or an integer by a mixed number, add the product of the integer and fraction to the product of the two integers.

Example: $32 \times 2\frac{1}{5}$.

$$\begin{array}{rr} & 32 \\ & 2\frac{1}{5} \\ \hline \frac{1}{5} \times 32 = \frac{32}{5} = & 6\frac{2}{5} \\ 2 \times 32 = & 64 \\ \hline & 70\frac{2}{5} \end{array}$$

HISTORIC SPOTS IN PICTURESQUE FRANCE



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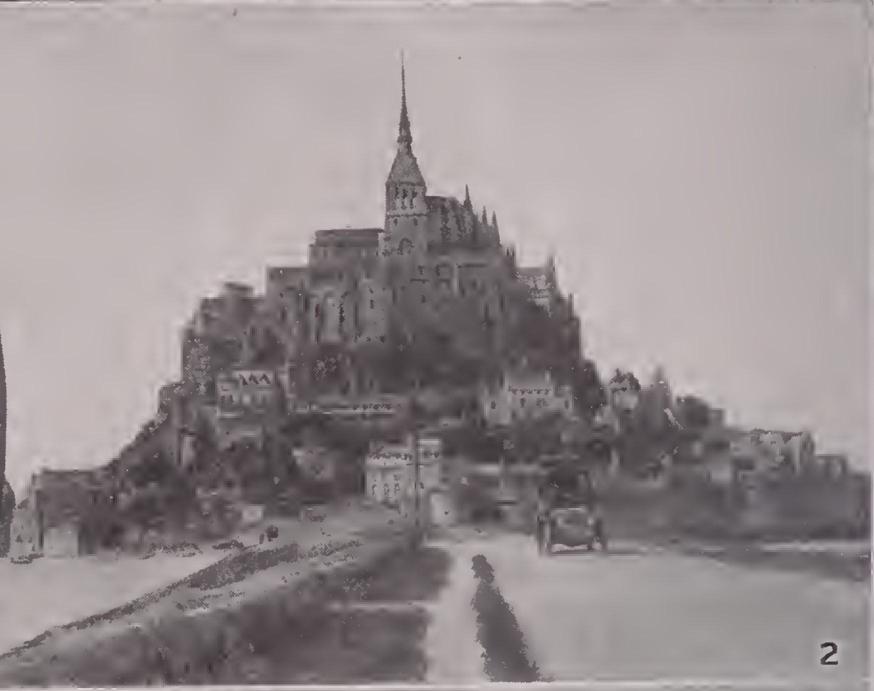

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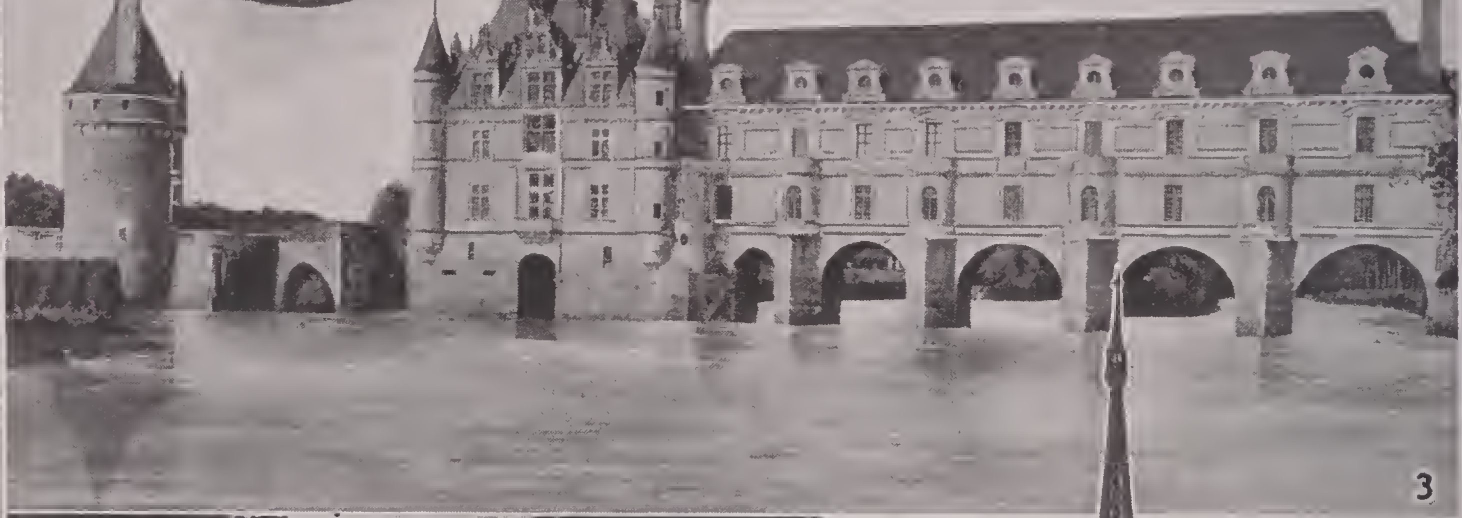

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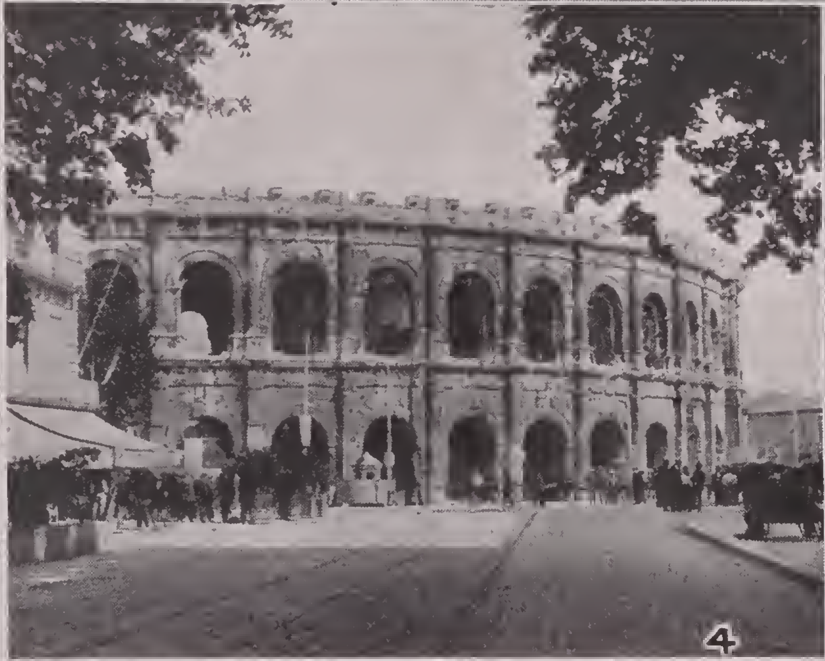

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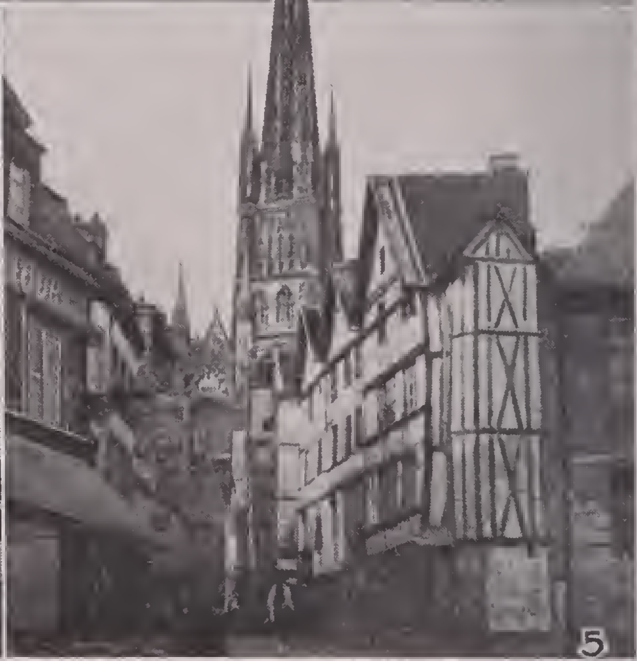


5

1. One of the seven noted gates of the city of Nancy. 2. Mont Saint-Michel, a curious town crowned by an ancient abbey-fortress on a rocky islet off the western coast of France. 3. Château of Chenonceaux with its gallery built astride the Cher River. 4. Ruins of the old Roman arena in Nîmes. 5. View of an old street in Strasbourg.

"*A* NAME *that* RINGS *Like a* BATTLE-SONG"

Extent.—North to south, about 600 miles; east to west, 400 to 570 miles. Coast line: English channel, 672 miles; Atlantic, 831 miles; Mediterranean, 369 miles. Area (including Corsica and Alsace-Lorraine), 212,822 square miles. Population, about 41,000,000.

Physical Features.—Alps (Mont Blanc, 15,780 feet), Pyrenees, Jura, and Vosges mountains. Rhone, Garonne, Loire, Seine, Somme, Meuse, and Moselle rivers; the Rhine now forms part of the eastern boundary. Climate, temperate; semi-tropical on south coast.

Products.—Textiles (cotton, woolen, linen, silk), laces, clothing, objects of art and fashion; coal, machinery, iron and steel, porcelain, glass, and chemicals; wines and cider; grains, potatoes, sugar, etc.

Principal Cities.—Paris (capital, more than 2,888,000 population); Marseilles, Lyons (more than 500,000); Bordeaux, Lille (more than 200,000); Strasbourg, Nantes, Toulouse, St. Etienne, Nice, Le Havre, Rouen, Roubaix, Nancy, Reims, Toulon (more than 100,000).

Colonies.—In Asia, Indo-China; in Africa, Algeria (treated as a part of France proper, for most purposes), Tunis, Morocco protectorate, French Equatorial Africa, Madagascar, etc.; in America, French Guiana, Martinique, Guadeloupe; various islands in the Pacific (New Caledonia, Tahiti, Marquesas islands, etc.). Total area of colonies, about 4,000,000 square miles; population, about 49,000,000.

FRANCE. The geographical position of France, as well as her stirring history, have fitted her for an important rôle in world affairs. Situated at the cross-roads of western Europe, France is the least isolated of the great nations. She faces in every direction and has no "back door." To the north, her close neighbor is Great Britain; to the east, Belgium, Germany, Switzerland lie at her gates; to the south, Italy and Spain; a bare day's sail separates her from Africa; and the sea route to the Balkans, the near East, and the Suez Canal passes by her southern shores.

Bordering at once on the Mediterranean, the Atlantic, the English Channel, and the edge of the North Sea, France belongs equally to southern and northern Europe—to the old era and to the new. When Rome was the center of the civilized world, Gaul—as France was then called—was a notable part of her Empire; and when medieval Venice and Genoa controlled the world's commerce, the French were close at hand to play their part. Then, when the scene of power shifted from south to north through the discoveries in the New World, along the African coast, and in the far Pacific, turning men's eyes away from the "middle sea," France retained the importance which was lost by other Mediterranean lands.

IN MEMORY OF FRANCE'S HEROINE

The sublime patriotism of the French people finds its ideal in the figure of Joan of Arc. There is hardly a village in the land that does not have a statue of this girl warrior to inspire young and old with thrilling memories.

It is only natural that, in a region so open to the world, we should find a varied racial mixture. Traces of several important prehistoric races abound in France (*see* Cave Dwellers); but at the dawn of recorded history most of France was inhabited by the Gauls, a people of Celtic blood. In the southeast, however, lived the Ligurians, of the same race as the ancient dwellers in northern Italy; and in the southwest the Iberians, probably survivors of a widespread race who had inhabited western Europe before the coming of the Celts.

Phoenician merchants settled at a very early date on the Mediterranean coast; and about 600 B.C. Greek traders founded the colony of Massalia (modern Marseilles), and rapidly extended their commerce far into the interior. Then, in the succeeding centuries, came the Roman conquerors, under whom Gaul became thoroughly Romanized. The invasion of the Germanic tribes followed—the Visigoths, the Burgundians, and the Franks, the latter giving the land their own name and supplying a dominant influence which was never overthrown. Moors or Saracens from Spain settled for a time north of the Pyrenees and exercised a fleeting rule; and fair-haired Northmen from Scandinavia made their homes along the English Channel and became in time the Normans.

All these later settlers were more or less absorbed by the original Gallo-Roman population, but some of them worked profound changes in the customs and physical appearance of the native inhabitants. To these influences must be added those arising from the later immigrations of Italians, Spaniards, Germans, Dutch, and other nationalities and peoples, reflected in nearly any list of representative French names.

France, which is only about four-fifths as big as the state of Texas, presents to this day marked differences in the types of her people. In Normandy, for instance, we find the tall, blue-eyed, light-haired descendants of the viking Northmen. In the southern provinces—Gascony, Languedoc, and Provence—the short dark-haired pre-Celtic type prevails. In Brittany we have people of purest Celtic descent, still speaking a Celtic tongue; while on the north slopes of the Pyrenees live descendants of the ancient Iberians, called the Basques, who have kept alive a language whose origin is largely a mystery.

But All are Devoted to France

But despite these reminders of a varied origin, the people of France today are animated by a spirit of unity scarcely equaled in any other country. The Gallic "melting pot" has fused the diverse elements. The glories and disasters of a stirring and eventful history have welded and forged and tempered them into a nation whose power and vitality have more than once astonished the world.

This spirit is made up of strongly contrasting qualities. On the one hand we see hard-headed thrift, typified by the peasant land-owner. "Jacques Bonhomme" ("Goodman Jacques"), as he is called, is the backbone of the nation, and he is so strongly attached to the soil of his forefathers that his kind has never followed the example of other Europeans in emigrating in considerable numbers to foreign lands.

France is shaped roughly like a pentagon or five-sided figure. Its apex lies just beyond Calais on the North Sea; the Pyrenees Mountains and the Mediterranean make up the base; the Atlantic and the English Channel form the western and northwestern sides; and Belgium, Luxemburg, and part of Germany, and Switzerland and Italy, the northeastern and eastern sides respectively. The greatest length north to south is about 600 miles; the greatest width about 570 miles. The island of Corsica, which lies more than 100 miles from the mainland coast in the Mediterranean, is an integral part of France (*see* Corsica); and for most purposes Algeria, a night's sail across that sea, in Africa, is also treated as an equal part of the republic and not as a colony (*see* Algeria).

THE NAME OF FRANCE

Give us a name to fill the mind
With the shining thoughts that lead mankind,
The glory of learning, the joy of art,
A name that tells of a splendid part
In the long, long toil and the strenuous fight
Of the human race to win its way
From the ancient darkness into the day
Of freedom, brotherhood, equal right—
A name like a star, a name of light,
I give you France!

Give us a name to stir the blood
With a warmer glow and a swifter flood
At the touch of courage that conquers feud—
A name like the call of a trumpet, clear
And silver-sweet and iron-strong,
That brings three million men to their feet
Ready to march and ready to meet
The foe who threatened that name with wrong—
A name that rings like a battle-song,
I give you France!

Give us a name to move the heart
With the strength that noble griefs impart—
A name that speaks of the blood outpoured
To save mankind from the sway of the sword—
A name that calls the world to share
The burden of sacrificial strife
Where the cause at stake is the world's free life
And the rule of the people everywhere—
A name like a vow, a name like a prayer,
I give you France!

—Henry van Dyke.

The western coast line of France shows two pronounced land projections—the Norman peninsula (called "Cotentin"), which reaches out into the English Channel, with Cherbourg in its head; and the rock-bound peninsula of Brittany, with the thriving maritime city of Brest near its westernmost point. In the angles between the Norman and the Breton peninsulas lie the Channel Islands—Jersey, Guernsey, Alderney, and Sark—still ruled by the English crown, though the rest of Normandy has long since been lost to it.

The broad sweeping curve of coast between Brittany and Spain is known to us as the Bay of Biscay, though the French usually call its lower angle the Gulf of Gascony. The deep depression in the coast of Languedoc, on the Mediterranean, is called the Gulf of the Lion.

Why France is Lacking in Harbors

The seacoasts of France are usually either dangerously rocky, or low and sandy, so that there are comparatively few good harbors aside from the mouths of rivers. Of these river ports the most important are Le Havre and Rouen on the Seine, St. Nazaire and Nantes on the Loire, and Bordeaux on the Garonne. The Rhone, owing to the great quantities of sediment carried down by its rapid current and the low swampy character of the delta at its branching mouth, offers no good harbor facilities. The principal seaports which are not situated on rivers are Marseilles, the largest of all; Cherbourg, guarded by a huge breakwater and an important naval station; Boulogne, Dunkirk, and Calais, in the extreme north; La Rochelle on the west coast; and Cette on the Gulf of the Lion opposite Marseilles. Brest in Brittany, and Toulon on the Mediterranean, are important naval stations and figured largely in the World War, but have comparatively little general commerce.

It is mostly a smiling and fertile land that the French have inherited from their ancestors. A line drawn from Bayonne in the southwest to the wooded hills of Ardennes on the northeast border roughly divides the rolling plains of western France—less than 600 feet high—from the highlands of the east. In the midst of the highland section lies the confused mass of the Auvergne Mountains with summits rising to 6,000 feet and hundreds of extinct volcanoes; adjoining them to the southeast lies the chain of the Cévennes, extending some 200 miles, from the foot-hills of the Pyrenees to beyond Lyons. To the east separating Alsace from the rest of France are the forest-clad Vosges; along the border of Switzerland rise the more important Jura Mountains (*see* Jura Mountains); while from Switzerland to the sea, along the whole Italian frontier, stand the mighty peaks of the Alps. The summit of Mont Blanc (15,780 feet), which lies seven miles inside the French boundary, is the second highest peak in Europe, being surpassed only by Elbruz peak in the Russian Caucasus. In Brittany and Normandy are minor groups of hills and mountains, some of them exceedingly rugged, but of no great height. North of the River Loire in what is called the "Paris basin" the successive low elevations have a uniformly gentle slope toward the west, but toward the east they present abrupt faces. This striking peculiarity, which renders difficult military invasions of France from the east, explains why Germany broke her plighted word in 1914 and violated Belgium's neutrality in order to find an easier and quicker way into the French republic.

Four great river systems—the Rhone, the Garonne, the Loire, and the Seine—each with numerous tributaries, drain the well-watered soil of France. The Rhone, which carries the greatest volume of water, rises in Switzerland, flows into Lake Geneva, then out again, and enters France through the gap between the Jura and the Alps. At Lyons it picks up the waters of its great tributary, the Saone, and is turned sharply to the south by the bluffs of the Cévennes Mountains. The Rhone valley from this point to the Mediterranean coast is one of the most picturesque parts of France, but the lower river is scarcely navigable on account of the swiftness of its current and shifting channel (*see* Rhone River).

The Garonne River in the southwest gathers its waters about equally from the Pyrenees and the western slope of the Cévennes. After uniting with the Dordogne near the Atlantic coast, it forms the broad estuary called the Gironde. The Loire is the longest of French rivers, rising also in the Cévennes southwest of Lyons, and crossing the whole breadth of central France, gathering numerous tributaries and pouring into the Atlantic south of the peninsula of Brittany (*see* Loire River).

In northern France the Seine, after collecting the waters of the Paris basin, winds sluggishly across the Norman plain and empties into the English Channel at Le Havre (*see* Seine River). On its chief tributary the Marne, and on the Aisne, which flows into the Oise, another tributary, occurred some of the most important battles of the World War.

Nothing could be more typical of the soaring French genius than the majestic Eiffel Tower in Paris. It was designed and erected by the famous French engineer, Alexandre Gustave Eiffel, for the Paris Exposition of 1889, and with its height of 984 feet still enjoys the distinction of being the world's tallest structure. After the Exposition, the French preserved it, as a fitting example of how the nation's designers combine good taste and artistry in all their engineering works. It still stands as a monument to engineering skill, an observation tower for sightseers, and an important government station for wireless telegraphy and meteorological observations. Sightseers are carried by elevators as high as the third platform from the ground, and from there on clear days may view the countryside around Paris to a distance of 85 miles.

In addition to these four river systems, there are several other streams that need mention. The little river Somme, which parallels the Seine 50 miles to the north, has been famous in history since the campaign which led to the battle of Crécy in 1346. The Meuse and the Moselle rivers, which rise in northeastern France, have most of their course in Belgium and Germany, respectively. The Rhine also may now be reckoned as partly a French river, for it forms the eastern boundary, since Alsace-Lorraine has been restored to France.

All the streams mentioned are more or less navigable; and connecting as they do with a great network of canals, they form a system of waterways extremely valuable to French industry and commerce. The Canal du Midi, which dates from the reign of Louis XIV and connects the Mediterranean with the Garonne River and so with the Atlantic, is one of the most famous of French canals. There are others that join the Rhone, the Loire, the Seine, and the Rhine systems each to the other, so that heavy freight can be carried entirely by boat to and from every important industrial region. It is estimated that one-fourth of France's internal trade is carried on in this way.

A ROADSIDE SHRINE

The countryside in France abounds in statues and monuments of a religious character. This one, representing the crucifixion, is typical of the elaborate roadside shrines of Brittany, before which the peasants stop to pray. The figure of the man at the right shows the immense size of the monument.

The greatest industry of France is agriculture. About half of the inhabitants earn their living on farms. The winds from the Atlantic Ocean, unchecked by coastal mountain ranges, carry abundant moisture to practically the whole land, and this produces a climate favorable to a wide variety of crops. Only in the extreme southwest, where a straight monotonous stretch of sand dunes along the sea borders the moors of the "Landes," is there much unproductive soil.

Wheat leads all the cereals, particularly in the broad Paris basin, and France ranks as a great wheat-growing country. Yet the French are such great eaters of white bread that they must import millions of bushels of this grain each year from America and from other great wheat-growing countries of the world. Oats rank next, and rye and barley are raised on the poorer soils of the coast and of the eastern mountain regions.

Sugar beets, grown exclusively on the rich plains of the north, provide the raw material for hundreds of sugar factories and refineries. A coarse tobacco is grown in some scattered parts of France, but its cultivation, manufacture, and sale is a government monopoly yielding a revenue of about $90,000,000 a year to the French treasury. Hops, flax, and hemp also cover a large area.

Among vegetables, potatoes take the first rank, as is to be expected in the land where the scientist Parmentier first popularized the growing of that tuber as food by inducing King Louis XVI to wear the flower of the plant in his buttonhole. All districts have their rich truck gardens. The French, particularly the peasants, eat very little meat—carrots, beans, peas, lentils, cabbage, spinach, etc., being their principal fare next to bread.

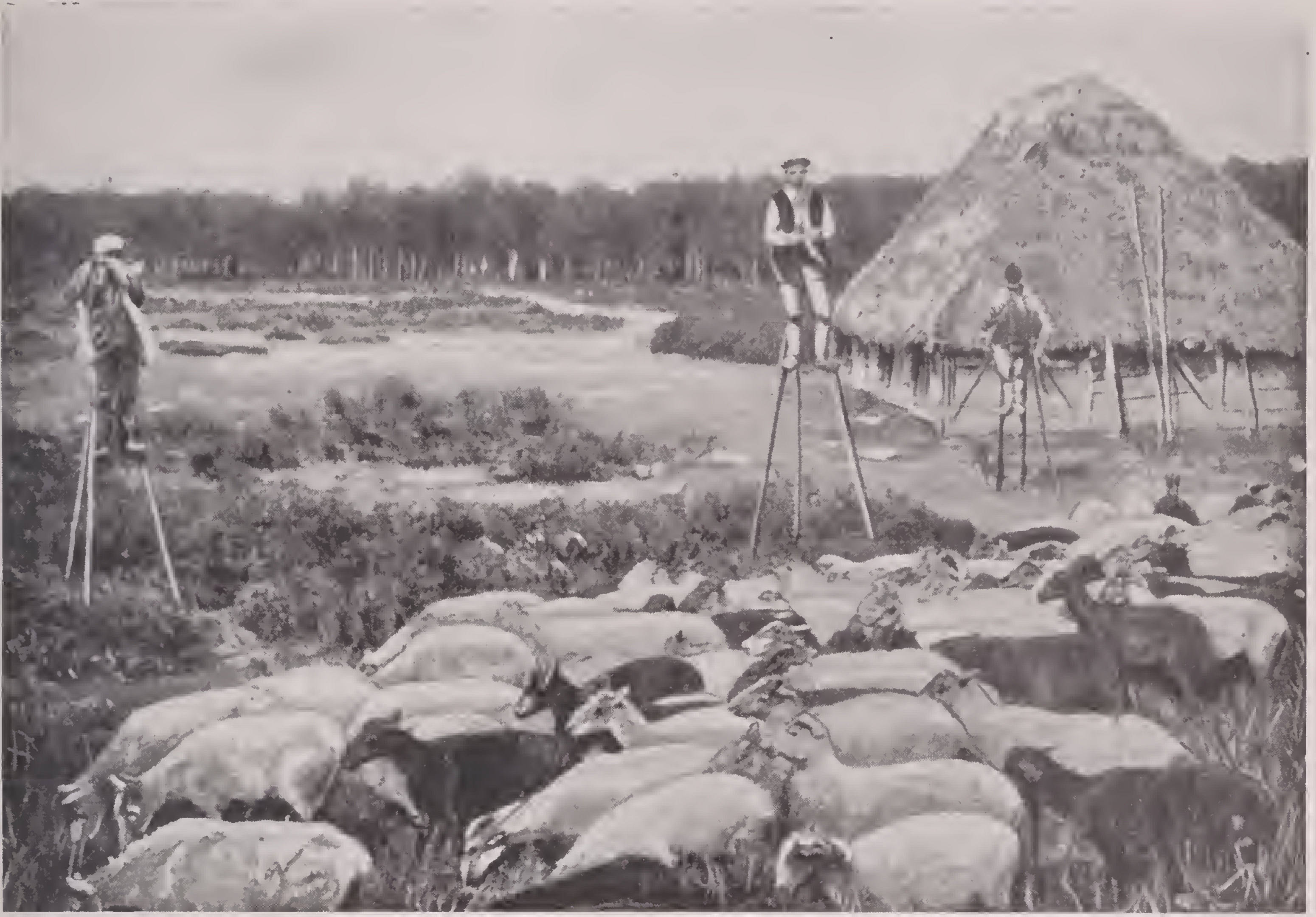
More wine is produced in France than anywhere else. The mild cheap red or white varieties are generally consumed, filling in a large measure the place occupied by tea and coffee in other countries. The provinces of Champagne and Burgundy, the regions about Bordeaux, the valleys of the Loire, and the Rhone, and the hills of Languedoc in the south, are famous the world over for the products of their vineyards. In Brittany and Normandy, where grapevines do not thrive, cider is produced in large quantities.

The grassy meadows that dot the great French plain produce quantities of beef and dairy cattle; and the northern provinces are the homes of famous breeds of draught horses—Breton, Norman, Percheron, Flemish. The slopes of the Pyrenees are noted for their mules; hogs thrive everywhere; sheep and goats are raised in great numbers on the high pasture lands of the Cévennes, the Vosges, and the Jura; and vast quantities of poultry and eggs are marketed in all sections.

Small Farms and What They Mean to France

Despite the enormous difference in the size of the two regions, there are today more farms in France (about 5,000,000) than in all the great farming district of the middle western United States. This is due

IN THE LAND WHERE "GROWN-UPS" WALK ON STILTS



Here is a group of shepherds in the Landes region of southwestern France, where stilts are a part of everyday life. Notice that each man is supported on three long poles. Two of them are the stilts, lashed firmly to the legs; the third is a kind of long "cane" with which the shepherds balance themselves when walking and which they use to make a sort of tripod when standing still. The stilts serve to make walking easier over the great tracts of sandy marshland of which the Landes region is largely composed. Women use them as well as men, and it is not uncommon to see shepherds' wives propped on these high perches, placidly knitting.

to the fact that the land, since before the days of the French Revolution, has been divided up among many small owners, and the laws of inheritance and the custom of the people tend to perpetuate these small holdings. The average size of French farms is about 17 acres, while the average size of American farms is more than 130 acres. It is this peasant ownership of the soil which tends to promote thrift, hard work, and intensive cultivation on the one hand, and on the other that "attachment to the soil," and spirit of independence which comes to the farmer who "works for himself." Socialism, which has long been popular in French industrial centers, has invariably met an insurmountable obstacle in the French farmer who clings to private ownership of land.

MAKING WORK PLEASANT IN BRITTANY

The French have a peculiar genius for enjoying their work. These peasant women, for instance, combine their lace-making with a little afternoon gossip, and their expressions show that the arrangement suits them completely.

France ranks high among fishing countries. The north coast provinces send large fleets each year to the haunts of the cod in the waters of Newfoundland and Iceland, as well as to the haunts of the herring schools of the North Sea. On the west coast oysters and sardines are taken, and in the Mediterranean sardines, anchovies, and tunny.

About 18 per cent of the soil of France is covered with forests, especially the more mountainous regions; but the supply of lumber for building is limited and France imports large quantities from northern Europe, together with woods from the tropics for manufacturing furniture. The quarries of the highlands, however, produce plenty of stone for construction work, particularly granite. The typical French farmhouse is built of stone with a thatched roof, the barn also of stone, and most of the old land boundaries are low stone walls.

Rich Iron and Coal Deposits

The greatest of France's mineral resources are her iron and coal deposits, on which are based her important manufactures of engines, machinery, automobiles, etc. Since the return of Alsace-Lorraine, France has been one of the greatest iron mining countries in Europe, her chief mines being in Lorraine. Most of the French coal mines, which are much less extensive than the iron deposits, are along the Belgian border; and many of these mines were seriously damaged by the Germans during the World War. As partial compensation, Germany's rich coal fields in the Saar basin, a district about two-thirds the size of Rhode Island, lying just across the border from Lorraine, were given to France by the peace treaty, the administration of the district being committed for 15 years to the League of Nations. The principal centers of French steel and iron manufacture are Lille in the far north, Nancy, Le Creusot (where most of the big guns of France are made, and which is situated between the Loire and the Saone), and St. Etienne, one of the most important industrial cities lying between the upper Loire and the Rhone. The last two have their own coal deposits close at hand.

A DAUGHTER OF FRANCE

This smiling girl is from Provence, in southern France.

Where Industries are Fine Arts

The textile industries of France are famous the world over. The city of Lyons on the Rhone is the greatest silk center in Europe. Normandy, and particularly the city of Rouen, is noted for its cotton cloth, two-thirds of the raw cotton being imported from the United States through Le Havre. Woolens, which rank high among French exports, are mostly manufactured in the region from Lille to Reims. Linens are made in Lille, Roubaix, and other northern towns. The laces of Normandy and Brittany, notably the hand-worked lace of Alençon (point d'Alençon), bring high prices on both sides of the Atlantic.

France is distinguished also for her fine leather goods, the exquisite porcelains of Sèvres and Limoges the cut glass of Baccarat, the jewelry made chiefly in Paris and its environs, the perfumes distilled from the flowers of her sunny Mediterranean border, and countless other articles of art and fashion. In general, French factories are remarkable rather for the good taste and fine quality of their goods than for quantity of production; and vast establishments with up-to-date machinery are the exception.

More than in any other great nation perhaps, the life of France centers in its capital. Paris is the actual heart of the nation's commerce and industry, of its social and political affairs. The wonderful system of French roads, built up and extended from the famous old Roman roads, focuses upon Paris. All the big railway lines, partly owned by the government and partly by private companies, converge there, and so do the waterways. Frenchmen who wish to play a big part in the affairs of their nation must go to Paris. And although Paris life as seen by the tourist by no means reflects the true life of the French, it is there that political, literary, and artistic history is made. So strong is the intellectual and artistic influence of Paris that it extends far beyond the borders of France, so that it has been called the "modern Athens" and the "intellectual capital of the world" (*see* Paris).

A FINE DAY'S "CATCH"

The greatest asset of France is the sturdy industrious character of her people. Here is a French fisherman with his "catch" on his back and his trusty fish spear. His whole appearance tells of thrifty independence.

It has been said that every man has two countries, "his own and France." This suggests truly the charm

TWO CHARMING BITS OF SOUTHERN FRANCE

The whole coast of the Mediterranean from Cannes to the Italian frontier is a fairyland of beauty known as the French Riviera. Mile after mile it stretches, with famous resorts, quaint villages, and vistas of incomparable beauty. This view, typical of the many seaside promenades to be found in the region, gives an idea of the charm of this part of France.

The Palace of the Popes in Avignon on the Rhone is one of the famous historic structures of southern France. It was built between 1316 and 1370 during the period when the papal seat was at Avignon.

that foreign visitors find in this smiling land. The most striking thing is the evidence found everywhere of France's stirring history. Perhaps it is an old walled city such as Carcassonne, whose stone towers and battlements still stand much as they were in the far-off Middle Ages. Perhaps it is the marvelous triple-arched Roman aqueduct, flung across a river valley near Nimes 18 centuries ago and still standing in its majestic simplicity. Or it may be the twin spires of William the Conqueror's famous Abbey church at Caen in Normandy, or the queer crooked streets of Rouen and the ancient houses that once looked down upon the procession which bore Joan of Arc to the stake. Those who have seen the great Gothic churches which, like gigantic carved jewels, dot the surface of northern France—at Amiens, Chartres, Le Mans, Reims, Paris, etc.—can never forget their soaring grandeur. And those who have visited the famous châteaus of France—Chinon, Loches, Amboise, Chambord, Chenonceaux, Azay-le-Rideau in Touraine, and the ruins of Coucy, Gaillard, and Pierfonds elsewhere—have read some of the most stirring pages of French history in letters of stone.

But the list is endless; almost every town and village has its own romantic or tragic memories of the past. Besides these great monuments of the past, France possesses in the Palace of the Louvre in Paris, and elsewhere, some of the rarest museum collections in the world—immortal paintings and statues, rare documents, remains of prehistoric peoples gathered from the caves of the southern provinces, an endless array of priceless memorials which attract each year students of art, of history, and of science by thousands from all parts of the civilized globe.

IN FRANCE'S FAMOUS VINEYARDS

Growing grapes for the manufacture of wine is one of the leading industries in France. The supremacy of the French vineyards depends largely upon the patience and skill with which they are cultivated.

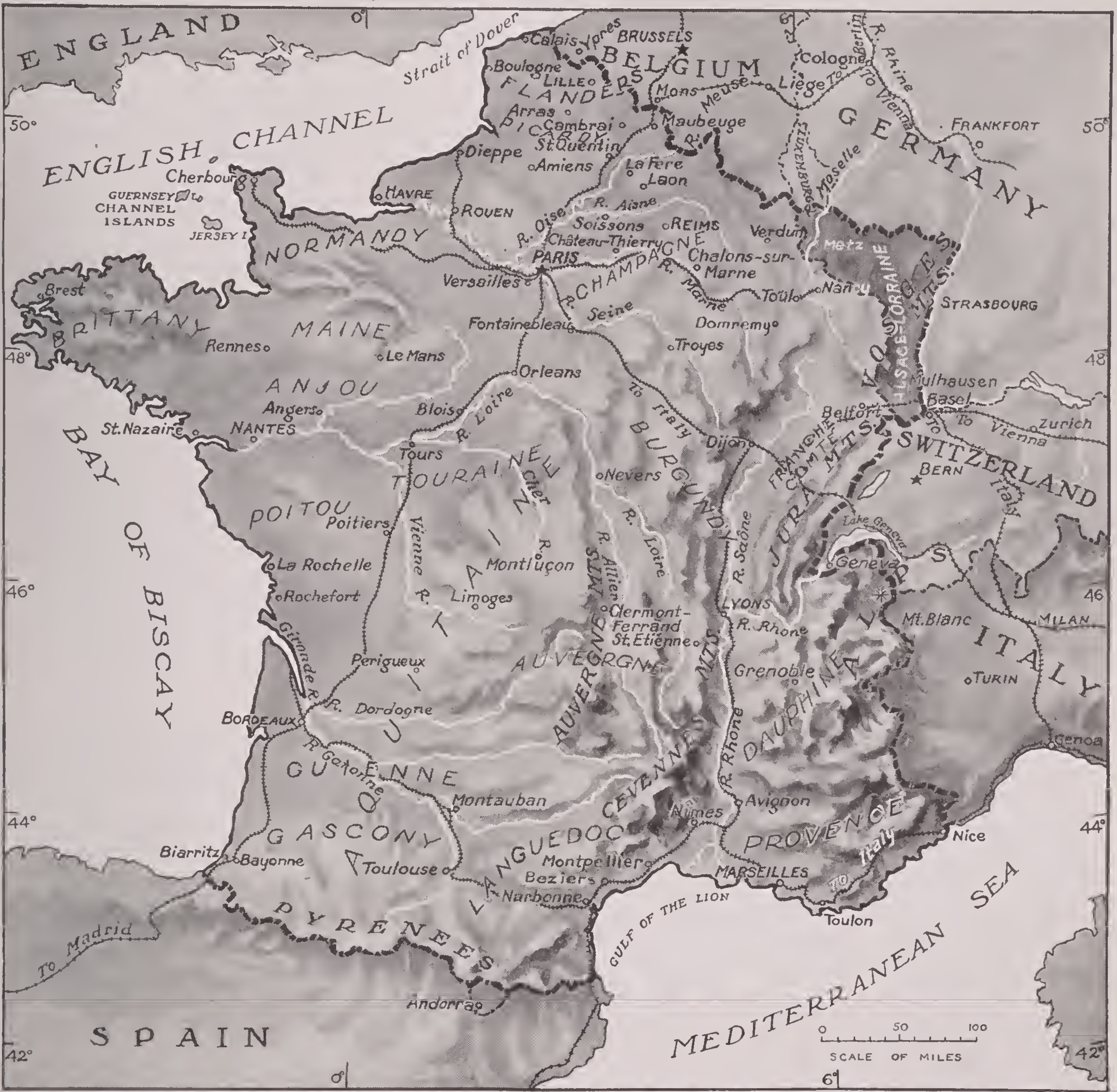
Everywhere the tourist and the student find inspiring associations and reminders of the great men and women who shaped France's destiny. Here St. Bernard's fiery eloquence launched the Second Crusade. There the great comic dramatist, Molière, spent his childhood. Here Victor Hugo sat writing that wonderful book, 'Notre Dame'. In this village Pasteur showed doubting scientists how germ diseases could be warded off. In that house the chemist Lavoisier stayed awake for 12 days and 12 nights, and then announced the discovery of oxygen, which led to the founding of modern chemistry. And what solemn memories of more recent events must come to the American or Canadian who visits the battle-fields of the World War, where they fought side by side with the British and the French—the Argonne Forest, the Marne valley, the hills of St. Mihiel, Ypres, Verdun, Vimy Ridge, Château-Thierry! The ruin and desolation of that vast conflict are mostly obliterated, but many a shattered church, many a broken forest remain to remind of those days of blood brotherhood. But more than all else, it is the charm of the French people themselves that remains in the visitor's mind. Courteous, hospitable, quick to smile, and quicker to understand a stranger's ways, they create an elusive atmosphere of "at-homeness" which has led many a world-weary traveler to settle permanently in beautiful France. They call it *savoir-vivre,* which may be translated as the art of knowing how to get the most and the best out of life, combining work and pleasure.

"JACQUES BONHOMME" AT HIS WORK

France rightfully regards her farmers as the very foundation of the nation. Their industry and thrift underlie the prosperity of the entire country.

France is a republic, its form of government being modeled on the parliamentary plan. For administrative purposes, the country is divided into about 90 "departments" in each of which a certain number of

THE QUEEN OF THE THREE SEAS



One of the reasons for the greatness of France is that her coasts command three great seas—the Mediterranean, the Atlantic, and the North Sea, at the Strait of Dover. Instead of the names of the 89 "departments" into which France has been divided since 1791, this map gives the names of the old "provinces" which have been made famous through centuries of history, and which are still in popular use. A glance at the map will show how completely Paris is the center of the railway systems of the country.

deputies are elected for four years by popular vote of all male citizens 21 years old or over. These form the Chamber of Deputies which sits in Paris. The Senate or upper house of the Parliament is composed of about 315 members elected for nine years by special delegates, by the deputies, and by certain local officials in each district. The Senate and Chamber of Deputies jointly elect the President, whose term is seven years. Although he is the nominal head of the government, the true executive head is the premier or President of the Council of Ministers, who is selected by the President from the dominant political party, and who in turn chooses the other members of the ministry or cabinet. These ministers are usually members of the Chamber of Deputies or the Senate and are collectively responsible for their acts. An adverse vote in the Chamber of Deputies on any important policy of the ministry in power means that its members must resign and make way for a new set of ministers, chosen generally from the opposition.

The government in Paris names the "prefects" of all departments, who control the locally elected municipal councils, the mayors, etc. The government of France is thus completely centralized. Although a majority of the people are Roman Catholics, no religion is now recognized by the state.

Growth of France through 2,000 Years

AT the time of the Roman Conquest France was occupied by a large number of independent tribes, who were of "Mediterranean" stock (*see* Races of Mankind) and spoke various dialects of a Celtic tongue. The Romans found the conquest of these tribes no easy matter, but Julius Caesar finally overcame them and organized Roman government (58–51 B.C.). The Gauls, as the Romans called these natives, adopted the Roman dress, language, and customs. Christianity spread from Rome to Gaul and was widely accepted as early as the 4th century.

With the decline of the Roman Empire, German barbarian invaders entered Gaul. Chief among these were the Franks, who under Clovis (481–511) established Frankish rule over most of that land. His adoption of Christianity led to the conversion of all those who served him.

The Merovingian dynasty, of which Clovis was the founder, was thrust aside by a new family—the Carolingians—who had been the "Mayors of the Palace" and now gave new life to the declining Frankish state. The greatest ruler of this line was Charlemagne, whose reign belongs to world history. He became the supporter of the Christian church and was crowned Emperor of the Holy Roman Empire by the Pope in Rome on Christmas Day, 800 (*see* Charlemagne).

Charlemagne's empire after his death fell into three parts, the western part becoming the kingdom of France. But the word "kingdom" meant little, for the spread of the feudal system distributed the power of government among local rulers and left to the king little but nominal overlordship. Under the Capetian kings, of whom Hugh Capet was the first (987), this system—or rather lack of system—reached its height. (*See* Feudal System.)

Some progress was made under Philip Augustus (1180–1223), Louis IX (1226–70), and Philip IV (1285–1314). But France was still in a disorganized state when the Hundred Years' War with England (1337–1453) impoverished her and led to conditions approaching anarchy in many parts of the country. A French peasant girl, Joan of Arc, became the national heroine by turning the tide against the English, who were finally driven from the soil of France (*see* Hundred Years' War). France slowly recovered, and her kings—chiefly Louis XI (1461–81)—gradually were able to unify the nation and to centralize government in their own hands. Louis XIV (1643–1714) marked the culmination of the power of the sovereign. He was indeed "the state." His authority was envied by the sovereigns of Europe and his court was imitated (*see* Louis, Kings of France). Meanwhile Protestant (Huguenot) ideas spread in France in the time of Francis I (1515–47), and civil wars over religion followed which occupied the latter part of the 16th century. Though France had rejected Protestantism, partial toleration was granted by gallant Henry IV (1589–1610) in the Edict of Nantes (1598).

The 18th century witnessed a long struggle between England and France for colonial empire. The Treaty of Paris (1763) marked the loss by France both of her great dominions in America and her ascendancy in India. This loss, together with internal inefficiency and abuses of administration, brought upon the government much criticism. An educated middle class was growing up who were dissatisfied with the "old régime" and demanded an influence in the government proportionate to their wealth and education. The crisis came when the financial difficulties of the state, which had been increased by the help afforded to the American colonies in their struggle for independence from England, forced the government to call the Estates-General in 1789. Then followed the Revolution, an heroic struggle against foes within and without, in order to establish a new political and social order. The failure to set up an able and just

THE CHARGE OF THE CUIRASSIERS

This painting by A. Morot represents a scene typical of the Franco-Prussian War. It took place at Rezonville, near Metz, August 16, 1870. The French Imperial Guard was ordered to charge in the face of withering fire. To obey meant death, yet they rode forward at full gallop, crumpling the Prussian cavalry, only to be mowed down in turn by the German guns and rifle fire.

THE "HAUNTED DESERT" LEFT BY WAR

This is a street in the great city of Verdun, as it looked after the World War. Battered by months of cannon fire, it was reduced to a ruin as desolate as those ancient cities which have lain deserted for thousands of years in Oriental deserts. Today, the industry of the French has made prosperity smile again in these devastated areas.

government paved the way for Napoleon Bonaparte, who directed to his own profit the enthusiasm begot by the Revolution (*see* French Revolution).

French Revolution and Napoleon

As Emperor of the French (1804–1814) Napoleon attempted to make the French power supreme in Europe. The attempt failed, and in the peace of Vienna (1815) France was reduced to its former limits. But the great principles of the Revolution—nationality, constitutional government, and equality before the law—had laid the foundations not only of a new France, but of a new Europe. Perhaps the most permanent work of the Revolution was to give the French peasants the land, which they have continued to own to the present day. This wide distribution of land in small holdings remains characteristic of France and makes for conservatism.

But France was slow in accustoming itself to the new order. The Revolution of 1830 (July 27–29) overthrew the restored Bourbons—who had "learned nothing and forgotten nothing" in the great Revolution—and brought in the Orleanist prince, Louis Philippe, as a constitutional monarch. But he too fell in the Revolution of 1848 (Feb. 22–24); and after a tempestuous trial of a second republic, the Second Empire began under Louis Napoleon Bonaparte (nephew of Napoleon), who had a troubled but pretentious reign of 20 years (1851–1870) as Napoleon III.

The lightly begun but disastrous war with Germany (*see* Franco-Prussian War) ended the Second Empire. For several years the government of France was then unsettled, but with the establishment of the Third Republic (1875) a new stability and political control became evident.

In the World War of 1914–18, France gave abundant proof that a democratic government can be efficient. None of the Allies made greater contributions or endured greater sufferings. About 7,500,000 men were mobilized (one-fifth of the total population), and of this number 1,327,800 were killed, and 3,435,000 were reported wounded, missing, or prisoners. More than 9,000 square miles of northern France was occupied by the German armies. To the looting, burning, and other wastage committed during their advance to and repulse from the Marne in 1914, was added the wilful wrecking and looting of the northern manufacturing part of the country, and the systematic destruction wrought when they fell back to the "Hindenburg Line" in 1917. It was officially reported that 264 villages were destroyed at that time, with 38,230 houses and 225 churches. And this was only part of the damage done by the Germans to the fair land of France. None of the Allies produced better soldiers than the French or abler generals than Foch, Joffre, Pétain, and a score of others. And in no country did the civilized population show greater patience, courage, and patriotic endurance than this race which unthinking persons regarded as fickle and flighty.

In the Peace of Versailles France recovered Alsace-Lorraine (lost in 1871), was given the products of rich coal mines in the Saar valley as compensation for her own destroyed mines, and was promised other indemnity of great but indefinite amount. She was left the dominant power on the continent (*see* World War of 1914–18). But she had serious problems of finance to meet, and the question of a declining birthrate still worried her. Her people, however, settled down to work, industry revived, and the future looked hopeful.

FRANCIS I, King of France (1494–1547). When Luther launched his Reformation, in the early part of the 16th century, the destinies of Europe were in the hands of three young princes—Henry VIII, the imperious tyrannical ruler of England; Charles V, the cold, calculating, far-seeking king of Spain and emperor of Germany; and Francis I, the brilliant, ambitious, pleasure-loving sovereign of sunny France.

Francis I was born in 1494, and was the son of the Duke of Angoulême. His marriage to his cousin Claudia, daughter of King Louis XII, and the death of that monarch without a son brought him to the throne in 1515, at the age of 21. Like Henry VIII, Francis I was the embodiment of the spirit of the new age, and in his reign the Renaissance or "new birth" of learning and art, which had begun in Italy, flowered in France. He fostered learning and art, invited painters and scholars to his kingdom, founded libraries, opened schools of the New Learning, and built several of the finest palaces in France.

Not content with building up his kingdom within, Francis sought also to extend its boundaries by engaging in a series of wars with Charles V. His immediate object was to win the duchy of Milan in Italy; the more distant aim was to reassert France's claims to a supremacy throughout the whole of the Italian peninsula. These wars filled the greater part of Francis' reign and left France exhausted. He won a great victory at Marignano in 1515, but in 1525 he was defeated at Pavia and fell a captive into the emperor's hands. He was forced by Charles V to renounce his claims upon Milan, and to pay a huge ransom (1526). But as soon as he was free he revived his claims which he did not relinquish until 1544.

One unintended result of the long struggle over Italy was that it so distracted the attention of Charles V that Protestantism was given a chance to take root in Germany. In France, also, it found a fleeting foothold, only to be stamped out by Francis and his successors. The massacre in 1545 of the Waldenses or Vaudois, an heretical sect who had survived from the Middle Ages in the French Alps, also left a black stain on the memory of Francis I.

Francis II, King of France (1559–1560), was the grandson of Francis I, the son of Catherine de' Medici, and the first husband of the famous Mary Queen of Scots. He was weak in mind and body and died before his 17th birthday, after a year of nominal rule.

FRANCIS JOSEPH I, Emperor of Austria and King of Hungary (1830–1916). As a sequel to the insurrections which swept the Hapsburg dominions during the revolutionary year 1848, the weak-minded emperor Ferdinand abdicated in favor of his 18-year-old nephew Francis Joseph. The uprising of the Czechs in Bohemia was put down by General Windischgrätz who afterwards bombarded Vienna into submission. Lombardy and Venetia were reconquered by Radetzki, following two defeats of their ally Charles Albert of Sardinia-Piedmont. Finally Hungary, where the Magyars had proclaimed a republic under Kossuth, was crushed with the aid of a Russian army. The constitution which Francis Joseph had been terrified into granting was then withdrawn; and, until fresh violence again strained the seams of his patchwork empire, his German, Magyar, Slavic, and Italian subjects were ruled by an absolute despotism.

Austrian prestige suffered seriously in 1859 with the loss of Lombardy in war with France and Piedmont and in 1866 with the loss of Venetia and of leadership of the German states through defeat by Prussia. Hungarian disaffection once more became dangerous but this time prudent counsels prevailed over absolutism. The emperor in 1867 promulgated a constitution by which the empire of Austria and the kingdom of Hungary became two equal and almost independent powers, united only by the person of their common sovereign and by a common administration of military, financial, and foreign affairs (the "Dual Monarchy"). Francis Joseph retained a large measure of personal control, but he never again openly repudiated constitutional government.

To his mastery of the many languages and dialects of his polyglot realm, as well as to his tact, generosity, and attractive manners, he owed a large measure of popularity. Personal misfortune again and again assailed him. He lost his only son by suicide, and his wife by assassination; and popular sympathy inclined the more to him. It was often questioned whether the motley Hapsburg lands would not fall apart with his death, and this threw the old emperor's merits into higher relief. He was generally regarded as a moderating and conservative force in Europe.

Meanwhile, Austria had entered into close alliance with the German Empire, and together an ambitious policy was pursued in the Balkans and the Near East. The assassination of the Austrian heir-apparent, Francis Ferdinand, and his wife at Serajevo, Bosnia on June 28, 1914, afforded a dramatic opportunity to strike the decisive blow which, in the opinion of the two emperors, would settle Balkan affairs once for all. The ruthless harshness of the terms submitted to Serbia, which in the end plunged the world into war, was dictated by Francis Joseph personally, and he must share with William II the terrible guilt of this most dreadful of all wars. Francis Joseph did not live to witness the ruin he had wrought, for his reign ended amid the uproar and chaos of a war greater than that in which it began. It was left to his grandnephew and successor, Charles Francis, to see the utter ruin of Austria and the break-up of the Hapsburg states. (*See* Austria-Hungary.)

Two emperors of the Holy Roman Empire (Germany and the Austrian lands) bore the name Francis. FRANCIS I, son of the duke of Lorraine, is chiefly notable as the husband of the heroic Maria Theresa of Austria, whom he married in 1736, and through whose influence he was elected emperor (1745–65). But he left the cares of the wars with Frederick the Great of Prussia to his wife while he increased his private fortune.

FRANCIS II was the grandson of Francis I and was emperor 1792–1806. Napoleon's conquests so diminished his possessions that in 1806 he renounced the outworn fiction of the Holy Roman Empire and allowed that title to lapse. But under the title Emperor of Austria he reigned over the Hapsburg lands until his death in 1835.

FRANCIS OF ASSISI (*ăs-sē'zē*), SAINT (1182–1226). The father and mother stood in the doorway watching their lighthearted little son playing gaily in the streets with his companions. Turning to his wife with an indulgent smile, the father said proudly, "Francis likes fine clothes and a gay life, and can spend money freely. Our boy is like the son of a prince, and will have a courtly career!" The merchant's wife nodded, but answered with a half-sigh, "If he lives like the son of a prince now, hereafter he shall be a child of God!" The story is significant, even if not historical. But even the mother little dreamed that this bright careless boy should one day become one of the most famous saints of the Roman Catholic church, the founder of the great order of the Franciscans or Gray Friars, and one of the most beautiful characters in all history.

The future saint was born at Assisi, in central Italy, of a family named Bernadone. His father was a well-to-do merchant engaged in French trade. The great change in Francis' life took place in his early twenties, after a year's confinement as a prisoner of war and a serious illness. The old round of worldly pleasure and display no longer appealed to him; and he sold his property in order to give to the church, and began to tend the poor and the sick—even lepers. This conduct angered the father, and he disinherited his son. Then Francis, wearing the worn-out robe of a gardener, occupied himself with repairing tumbledown chapels around Assisi. At last, throwing aside even his stick, wallet, and shoes, like the apostles of old, he lived in absolute poverty, preaching simply to all who would hear him.

Soon this saintly man began to attract followers. In ragged gray gowns, barefoot, and without money, they went forth two by two to spread the gospel of service and divine poverty around central Italy. When he had a dozen followers Francis received Pope Innocent III's sanction to continue his missionary work. Later, as the "Begging Brothers" grew very numerous and were sent to preach and serve in France, Germany, Hungary, Spain, and England, the pope began to give them numerous privileges. The humble founder, fearing lest his order should become ambitious and powerful, drew up a rigid rule showing how "in poverty and humility serving God" they should remain absolutely possessionless, and should confidently seek alms and minister to the poor and sick. When a girl of 18 named Clare left her home to become a follower of Francis, he instituted a separate order for women known as the "Franciscan Nuns," or "Poor Clares."

For the rest of his life "little brother Francis," as he called himself, continued his Christlike labors. In various parts of the world he made long missionary journeys, even seeking martyrdom in the land of the Mohammedans. He gathered many new followers, had visions, and performed a bewildering number of miracles. Legends have adorned the simple facts of his life with many charming incidents. It is said that he loved all living things, that wild rabbits ran to him for protection, and that even wolves crouched like lambs at his feet. There is a pretty legend of his once preaching to the little birds, telling them how thankful they should be to God, their creator. He was a poet, too, and his lyric lines, rugged and imperfect in form, are very touching and beautiful—particularly in his famous 'Canticle of the Sun'.

At his death in 1226 it is said that on his body were found the famous "stigmata"—the marks of the nails and the spear of Our Lord's passion. Two years later he was canonized (made a saint) by the pope. He is lovingly remembered as the most blameless and gentle of all saints, the most Christlike figure of the Middle Ages. Twenty years after St. Francis' death his order had so grown that 9,000 religious houses had been erected for these simple preachers to the common people, and within a century the Franciscans or Gray Friars numbered 150,000. Even in St. Francis' own time his rigid rule of poverty proved too severe for some of his followers, notably the Friar General Elias, and dissensions crept in. By the 16th century the order had declined in influence and its members had lost much of their earlier joy in service.

FRANCO-PRUSSIAN WAR (1870–1871). "On to Berlin!" was the cry that echoed and reëchoed through the streets of Paris in the exciting days at the beginning of the Franco-Prussian War in July 1870. For four years, ever since Prussia had defeated Austria and won the leadership in Germany in 1866, the leaders of the Second French Empire had longed to humiliate this upstart power or to obtain "compensation" for its aggrandizement. And now that the opportunity had come they welcomed it.

For four years the Prussian rulers, too, had wanted war with France. Bismarck, the Iron Chancellor, was convinced that such a conflict was necessary before the unification of Germany could be completed. And he rejoiced when his scheme of altering the "Ems dispatch" before publishing it led France to declare war (*see* Bismarck, Otto von). The occasion of the war was the offer by the Spaniards of their vacant throne to a German Hohenzollern prince, distantly related to the Prussian king, William I. The offer was refused for politic reasons. Then came the blundering demand of France on the Prussian king that he should guarantee that his relative should never accept it; and Bismarck's unscrupulousness brought the war-spirit in both countries to fever heat.

"Everything is ready," declared the French minister of war, "to the last button on the last gaiter." But when the French troops began to mobilize it was found that almost nothing was ready. There were horses without harness, cannon without ammunition, machine guns without men who knew how to use them. Prussia, on the other hand, had been so completely prepared by General von Moltke that all that was necessary was to "touch the button" to set in motion the greatest army organization then known. The plan for the invasion of France had been formed long before and all that was needed was to take the necessary orders from the pigeon-holes, date them, and send them out to the commanders. France moreover stood alone without a single ally, while the South German states and the North German Confederation rushed to the aid of Prussia.

In an astonishingly short time after war was declared (July 19, 1870), German troops invaded France in Alsace and Lorraine. The French troops met them as best they could, and though they fought bravely they were defeated in one battle after another between August 6 and September 2. One of their armies was "bottled up" in the strongly fortified city of Metz, while the other on September 1 was fighting before Sedan. This proved to be "one of the decisive battles of the world—a battle that resulted in the surrender of the largest army ever known to have been taken in the field, a battle that dethroned a dynasty and changed the government of France." On September 2 the French army of nearly 100,000 men, with the Emperor Napoleon III himself, surrendered as prisoners of war.

Such a terrible disaster to France astonished the whole world. The early defeats of August had been announced by the governments as victories, but the deception could no longer be kept up. When Napoleon's message—"The army has been defeated and is captive; I myself am a prisoner"—arrived in Paris, the mob began to cry "Down with the Empire! Long live the Republic!" The Empress Eugenie fled; a republic was proclaimed, and a Government of National Defense organized (September 4).

Siege of Paris; Rats at 60 Cents Apiece!

For five months longer this provisional government carried on the hopeless struggle. It was ready for peace, but was resolved that "not an inch of our soil will we cede, not a stone of our fortresses." After Sedan the Germans hastened on to Paris, and on Sept. 19, 1870, began the famous siege of that city. For four months the capital bravely held out. Early in the siege the fiery Leon Gambetta, head of the new government, escaped from the city in a balloon and worked desperately to raise new armies. But there was no possibility that they could break through the circle of iron around the doomed city. The sufferings of the Parisians during the siege were terrible. Dogs and cats were eaten. The price of rats rose to 60 cents apiece. Fuel gave out. Only when starvation was upon it did the city surrender (Jan. 28, 1871).

The war was at an end. A government recognized by Germany was formed, with the aged statesman Thiers at its head, and made peace with Germany (Peace of Frankfort, May 10, 1871). The victors demanded harsh terms. The greater part of Alsace and Lorraine was to be given them. An indemnity of one billion dollars was to be paid, and until it was paid a German army was to remain in France. France was also humiliated by the German troops marching in triumph through the streets of Paris, and by the proclamation of the new German Empire (Jan. 18, 1871) in the French royal palace at Versailles. The hatred that these acts of the Germans aroused was not forgotten at the close of the World War of 1914–18, when the tables were turned and the French were victors and the Germans the vanquished.

Then Came the Commune

As though Paris had not endured enough during the siege and bombardment by the Germans, there occurred a desperate revolt in the city against the new government. The Parisian working men still had their arms, and they feared that the assembly would try to overthrow the new republic, so they rebelled and set up a government called the "Commune."

This revolt broke out on March 18, and lasted until near the end of May. Again the city was besieged, but this time by the French troops of Thiers. When the government troops entered the city there followed a week of fierce civil war. Indeed, Paris suffered more from the Commune than from the Germans. When at length the revolt was put down no mercy was shown the rebels. Hundreds were shot without trial. More than 7,000 were sent as convicts to New Caledonia, in the South Pacific Ocean, and thousands more were sentenced to imprisonment at hard labor. In addition to the legacy of hatred left by the war between France and Germany was the bitter anger of the French working classes for the new "bourgeois" republic, which enfeebled it for 20 years or more (*see* France).

FRANKFORT-ON-THE-MAIN, GERMANY. Someone has called Frankfort an old picture in a new frame. On the one hand you see the high gables of the old houses nodding sleepily over narrow streets; on the other, magnificent modern buildings and the villas of merchant princes. The old and the new seem inseparably united.

In the old segregated Jewish quarter of this German city may still be seen the home of Meyer Anselm Bauer, the founder of the famous Rothschild family of bankers. From this small money-lending shop *Zum rothen Schilde* ("At the Red Sign") was derived the name of this powerful group of banking houses, which have over and over again supplied European nations with the sinews of war.

Frankfort is still the seat of some of the most powerful financial institutions in the world. It is also one of the most important railway centers of Europe, and the headquarters of many of the leading industrial and mercantile associations of southern Germany.

It is situated in a picturesque plain surrounded by the Taunus Hills, and is divided by the navigable River Main into two parts, the larger being Frankfort proper, and the other Sachsenhausen. During the Middle Ages Frankfort was a free imperial city, and it did not lose its independence until it was annexed by Prussia in 1866.

Frankfort has had a notable history, dating from the time of Charlemagne, when it was called the "Ford of the Franks." The "Golden Bull" of the emperor Charles IV, dated 1356, made Frankfort the electoral city of the Holy Roman Empire of the German nation. After 1816 the German Diet or parliament held its sessions in Frankfort. During the revolutionary period of 1848, that brought to the United States some important German citizens, notably Carl Schurz, Frankfort was the center of German nationality and the battleground of parties.

Goethe was born in Frankfort in 1749 and lived there until 1775, and in that city his revered mother is buried. The Goethe house and the adjoining Goethe museum are among Germany's most cherished shrines. As a boy, Goethe loved to run in and out of the imperial hall in the famous Römerberg, to look at the portraits of the emperors.

The Staedal Art Institute in Sachsenhausen contains one of the best collections of engravings in Germany, 60,000 examples in all. The educational advantages of this Prussian city, with its famous "spas" (health resorts) in the vicinity—Wiesbaden, Kissingen, Nauheim—will always make it a center of European travel. The most elaborate monument of Frankfort is in honor of Gutenberg and the invention of printing, for this city was formerly the center of German book publishing. Population, about 415,000.

From PRINTER BOY *to* SCIENTIST *and* STATESMAN

How a Good Resolution, Well Kept, Changed a Bumptious Youth into One of the Most Famous of American Patriots, Diplomats, and Men of Letters

FRANKLIN, BENJAMIN (1706–1790). There is something perennial about the spirit of this great American patriot of civil life, philosopher, statesman, diplomat, and writer. Though born in the infancy of science, and dying in the infancy of the republic he had helped to establish, he projects himself into the interests and problems of today and of all times as does no other man who figures in American history. His many-sided genius, sound common sense, practical citizenship, hospitality to new ideas and ideals, and his moral courage make him a character to whom men of any age must have turned with confidence.

There is nothing in Franklin's ancestry or environment to account for him. In the family history for four centuries behind him there had not been one man who rose above mediocrity. In England the Franklins were small landed proprietors or tradesmen in Northamptonshire, simple, industrious, pious. The father emigrated to Boston in 1682, and set up in business as a candle-molder and soap-boiler. His tenth child was taken to the Old South Church, christened Benjamin, and dedicated to the ministry. Lack of money for the necessary education forced the boy to learn the printer's trade. Disputatious, sarcastic, vain, resenting control and given to expressing original opinions, the boy was not any too popular in the strict Puritan town. So, at 17, he ran away to Philadelphia. He landed with a silver dollar, a trade, plenty of self-confidence, and a suddenly formed resolution to turn over a new leaf, thus showing remarkable strength of character. Ever afterward he was noted for his good manners, avoidance of controversy, and patience.

At 23 he owned his printing office and was publishing the *Pennsylvania Gazette,* which survives today in *The Saturday Evening Post.* For the next 20 years he was the foremost journalist in the colonies. *Poor Richard's Almanac,* issued annually for a quarter of a century, made him known from city mansion to the remotest frontier cabin. While making fame and fortune as a printer, publisher, and writer, he was studying foreign languages and literatures, experimenting in science, and taking a conspicuous part in local affairs. From 1736, when he was chosen clerk of the Pennsylvania General Assembly, until 1785, when he returned from Paris at the close of the American Revolution, he was almost continually in the public service, and this without compensation. Big and little things alike claimed attention. Now he was organizing a police or fire department or local militia; now putting a street lamp before his gate and paving his sidewalk to rouse public spirit; organizing an Academy of Science; or a church free for all denominations; collecting books for the first free circulating library; organizing a system of colonial defense against the Indians; inventing rockers for his easy-chair and a portable fireplace, called the Franklin stove, for which he refused to take out patents. He always declared that as we are indebted to the ingenuity of men in the past, so it is only our duty to give our contrivances to the present and future. Although his early plans for a union of the colonies presented at the Albany Congress failed, as Deputy Postmaster-General under the crown, during a score of years, he linked them together with the ties of the postal service.

How He Served His Country Abroad

After 1747 (his 41st year) Franklin spent over a quarter of a century more or less continuously abroad in the services of his country. His discovery of the identity of lightning and electricity had already made him the best-known American in Europe (*see* Electricity). Learned societies and universities welcomed him, and he soon won equal distinction as a diplomat. Sixteen years in all he spent in London as the agent of the colonies. His chief triumph was in getting the Stamp Act repealed. An eminent English statesman declares that had the king and Parliament accepted Franklin's just contention that the American colonies were self-governing, owing allegiance only to the sovereign, the Revolutionary War might never have been fought.

Franklin, after more than a decade of working in vain for agreement between the mother country and the colonies, returned to help frame in Congress the Declaration of Independence, and to place $20,000 of his fortune at the service of Congress. He then crossed the sea once more, in December 1776, to win the help of France to the cause of American liberty. His position in Paris, although he represented poor rebel colonies, was extraordinarily influential, such as has rarely been equaled in the history of diplomacy. Camp and court and the world of science were at his feet. His simple dress became the fashion; his kindly face adorned ornaments of cameo; his portrait was in college, palace, and cottage. He was the first great plebeian standing upright before kings, and he fired the imagination of the people as he charmed the aristocratic court.

Franklin as the Ideal American

It is flattering to our pride to learn that the mind, character, and versatile genius of Franklin have been called an epitome of all that is best in the typical American. He won by straightforwardness. He had shrewdness, good nature, open-mindedness, persistence, and infinite knowledge of the world and of human nature.

When Franklin returned to America in 1785, he was in his 80th year and begged for rest. He could not decline the office of chief executive of Pennsylvania, nor membership in the constitutional convention of 1787 that drafted the Federal constitution. In spite of the infirmities of age, he continued to give scientific discoveries to the world. His last public act was to affix his signature to a memorial to the state legislature, as president of the Pennsylvania society for the abolition of negro slavery.

No life of Franklin is comparable to his own autobiography. As literature it is a classic, and as a human document it is unsurpassed in its candor.

FREDERICK, EMPERORS OF THE HOLY ROMAN EMPIRE. During the Middle Ages three rulers of that loose government which included Italy and Germany known as the "Holy Roman Empire" (*see* Holy Roman Empire), bore the name of Frederick.

FREDERICK I (BARBAROSSA) of the German house of Hohenstaufen ruled from 1152 to 1190, and was not only the greatest of the Fredericks, but was also, in many respects, the ideal emperor of the Middle Ages. He had a lordly appearance though he was only of medium height. His hair was yellow, and his red beard led the Italians to nickname him "Barbarossa" or Red-Beard. His ambition, as he wrote the pope soon after he became emperor, was to restore the position of the Roman Empire to the place it had occupied under the Caesars and under Charlemagne. To do this, he set about learning his rights as emperor and then attempting to enforce them.

But times had changed since the days of Charlemagne. Frederick had the strong city republics to contend with in Italy, and furthermore the pope was playing a larger part in European affairs than was formerly the case. In his attempt to govern the Italian towns, Frederick was eventually defeated by the "Lombard League" of northern Italy. These cities were henceforth practically independent, only the shadow of power being left to the emperor. Frederick was likewise unsuccessful in his contest with the pope, and was forced to humble himself before the head of the church (1177), much as Henry IV had done at Canossa, just one hundred years before.

In Germany, however, Frederick was more successful than in Italy, and his reign marks one of the most brilliant epochs in the history of medieval Germany. He established his power over the turbulent German nobles. The land was cleared of forests, agriculture was improved, and the country advanced in wealth and in culture.

Toward the end of his reign, Frederick Barbarossa "took the cross" and joined the Third Crusade. Before he reached the Holy Land he was drowned in a little stream in Asia Minor. Later generations, recalling the splendors of his reign, transferred to him a legend which had grown up about another German Frederick. He was not dead, they said, but was sleeping in a rocky cavern of a German mountain; when the ravens ceased to fly about the summit of the mountain, Barbarossa would awaken and return, to restore to Germany the glories of former times.

FREDERICK II, the grandson of Frederick Barbarossa, inherited the kingdom of Sicily from his mother when he was three years old, but it was not until his troops defeated those of a rival emperor, 17 years later, that he could claim the title of "Emperor of the Holy Roman Empire" (1215–1250). He was known as "the wonder of the world" because of his varied attainments. He was a poet, a lawgiver, and political reformer, and has sometimes been called the "first of modern men." His court in Sicily, where he spent most of his life—largely under Saracen influence—was the most splendid in Europe, and the laws of that kingdom the most advanced. But he neglected Germany in order to defend himself against the pope in Italy. The nobles and the towns north of the Alps came to exercise rights which belonged to the emperor, and Germany grew more and more into a confused mosaic of city states and feudal principalities. Frederick's going on a crusade (1228–29) was a mere episode in his conflict with the pope. Frederick was able to maintain his power until his death in 1250; but soon after that date the triumphant papacy over-

THE GREAT FRANKLIN OF THE BUSY BRAIN

That sturdy Ben Franklin, the soap-boiler's son, who is stirring the big soap kettle in the first picture, is the same Franklin whose genial wit and shrewd comments on life made him a social favorite among the aristocratic ladies of Paris, as shown in the last picture in the series. At 20 we see him as a printer looking over one of the sheets which have just come from the old hand-press. At 25 he is in the newspaper business and his comments on public affairs are being widely read. In the center picture we see him in his library—thumb under chin, his favorite attitude when reflecting. On the left of this picture he is making experiments with electricity; on the right he is testing the temperature of the Gulf Stream, from the deck of the vessel which is carrying him to England. Next we see him taking part in the peace negotiations which ended the American Revolution.

threw with French aid the whole Hohenstaufen house, root and branch.

FREDERICK III, who ruled from 1440 to 1493, was the first important ruler of the Hapsburg house, and his reign is called "the longest and dullest of all the reigns in German history." He was slow, poor, and powerless. All he could do was to watch the course of events, consoling himself with gardening and astrology, and muttering his favoite maxim, "What can't be helped had best be forgot." One thing he accomplished which left a lasting impression on history. A marriage treaty was made with Hungary by which that kingdom eventually became a Hapsburg possession. Frederick thus began that policy of "fortunate marriages" which built up the Hapsburg power.

FREDERICK THE GREAT, KING OF PRUSSIA (1712–1786). As a boy Frederick II, future king of Prussia, had a hard time. His father, rough old Frederick William I, planned an education for his heir that was military, practical, matter-of-fact. But the boy was fond of music, literature—especially French—and art. He hated military exercises; he would rather play the flute than play soldier; he detested tobacco, heavy eating and drinking, and hunting, which appeared to his father the natural manly and royal pleasures. The king forbade the prince's tutors to teach him Latin because it "had no practical use"; but Frederick studied the classics when his father knew nothing about it.

FREDERICK THE GREAT

The "Iron King" of Prussia, who, in his youth, preferred to play the flute rather than to play the soldier.

As Frederick became older matters grew worse. His mother and his sister Wilhelmina, a spiteful little minx who has left her story in print, sided with him against the father. The thought that this youth, so interested in the pleasures of life and so carelessly self-indulgent, would one day be king and would probably wreck the Prussian state by his incompetence, enraged the tyrannical, hard-working Frederick William, who thought only of Prussia's greatness. He became more and more severe with his son, even caning him in the presence of the army and boxing his ears in public.

When Frederick was 18 years old he decided to escape the tyranny of his father by running away. It was a wild scheme and he was caught before he crossed the border. He was kept in solitary confinement for a time, and from the window of his cell he was forced to watch the execution of his most intimate friend who had accompanied him in his flight. For a time the enraged king even thought of putting his son to death as a military deserter.

After this Frederick was changed. The iron had entered his soul and the father's discipline had triumphed beyond his fondest hopes. Frederick became self-contained, crafty, and cynical, but sobered and outwardly submissive. As the king said, he no longer "kicked and reared." He spent several years in the prosaic task of administering minor offices and learning the dry details of administration. Gradually his father entrusted him with greater responsibilities.

When he came to the throne, at the age of 28, Frederick had a keen mind, a character of iron, and an ambition that was soon to set the world on fire. He ruled for 46 years (1740–86). The first 23 years were devoted chiefly to unscrupulous warfare; the second to peace and recovery. The first half of his reign made it evident that as a soldier he had no equal in Europe; the second half showed him as one of the enlightened despots of the 18th century. Frederick worked hard himself, rising at 3 o'clock in the summer and at 4 in the winter. He was his own prime minister and his advisers were treated like clerks. But in his leisure hours Frederick wrote poetry and history and brought the French philosopher Voltaire to his palace of Sans Souci in Potsdam. But Voltaire wanted to be an arbiter of learning, not a mere corrector of Frederick's French, so the two quarreled. Voltaire left with a trunkful of Frederick's writings that the king did not desire made public, so Voltaire was stopped at Frankfort and his luggage searched.

War Becomes Prussia's "National Industry"

This man, who as a youth had hated the life of a soldier, plunged all Europe into war immediately after he came to the throne. Following his own advice—"Take what you can; you are never wrong unless you are obliged to give it back"—he seized the rich Austrian province of Silesia and so began a great European conflict (*see* Seven Years' War). It was in this struggle, lasting more than a score of years, that Frederick by his military genius won the title "the Great." He had truly made war "a national industry" in Prussia, and his motto was *Toujours en vedette* ("Always on guard").

During his reign he nearly doubled his kingdom in size, for he not only compelled Maria Theresa to cede Silesia to him, but also seized part of Poland in the first partition of that unfortunate country in 1772 (*see* Poland). In peace he vastly increased its resources by draining marshes, clearing forests, encouraging industries, opening schools, welcoming and favoring immigrants. Frederick reorganized the army, replenished the public treasury, and remodeled the legal code. He gave the Prussian nobility an assured place in the army and diplomatic service. He proclaimed himself "the first servant of the state," but it was a state which every class must serve in the way appointed by the sovereign, whose power was absolute.

Frederick raised the crude sprawling state of Prussia to the rank of one of the first powers in Europe, and gave it by his military successes and his crafty diplomacy the stamp of his own character. Strangely enough this greatest of the Hohenzollerns spoke and wrote French almost exclusively, and had France for an ally in his first wars. He died on the eve of the French Revolution, which was to shake forever the power of kings, and so was in a certain sense the last absolute king in western Europe. (*See* Prussia, Germany.)

FRED'ERICKSBURG, BATTLE OF. One of the bloodiest and most humiliating defeats suffered by the Union forces in the Civil War was that at Fredericksburg, Va., on Dec. 13, 1862. After his retreat from the north in consequence of his defeat at Antietam, Gen. Robert E. Lee with about 78,000 men had established himself on the high bluffs of the Rappahannock River near Fredericksburg. The Army of the Potomac, numbering about 120,000 men, under Gen. Ambrose E. Burnside, held the north bank of the river at Falmouth. Under great difficulties, Burnside got his men across the river on pontoon bridges, and attacked the strongly intrenched Confederates on the 13th. After six assaults had been repulsed with great loss, Burnside was dissuaded from renewing the attack; and on the night of the 15th, under cover of a storm, what remained of the Union Army was brought back to Falmouth. Burnside lost 12,653 men, while the Confederate loss was 5,309 men. As a result of the defeat, Burnside was relieved of his command a week later, and Gen. Joseph Hooker was appointed to succeed him.

The gloom in which this disaster enveloped the North was changed to rejoicing a few weeks later by the news of the Union victory in the battle of Murfreesboro, or Stone River, Tenn. (Dec. 31–Jan. 2) when the Confederate forces under Gen. Braxton Bragg were repulsed by Rosecrans' army. This repulse opened the way for the Union advance to Chattanooga, and eventually to "Atlanta and the sea."

FREEMASONS. The origin of the secret society known as the Ancient Free and Accepted Masons has been variously traced by tradition. It is said to have arisen from gilds of masons or stone-workers, which sprang into being in the Middle Ages; in order that traveling members might be accepted by their brother craftsmen they made use of secret signs and passwords. With less warrant other stories carry the origin of the order back to the building of the temple at Jerusalem in the days of Solomon.

Scotland possesses the earliest record of the presence of masons in lodges. Modern freemasonry, with the three symbolic degrees (apprentice, fellowcraft, and master mason) of the "blue lodge," dates from the early part of the 18th century. It was introduced into America in 1730; and nowhere is masonry held in greater honor or importance, as is shown by the fact that two-thirds of the Masons of the world are in the United States.

The many Masonic rites are now largely combined into the English, American, Scottish, French, German, and Swedish rites. These variously combine the degrees and ceremonies. In all, the emphasis is on the member's duty to his family, his country, and his God, and to aid his fellow members. A set of passwords and a peculiar grip of the hand enable the initiated to recognize one another.

The Order of the Eastern Star is made up of women relatives of Masons and of Master Masons. It was founded in 1868.

FREEZING. Mix some cracked ice or snow with a couple of handfuls of salt in a bucket and stand a test tube of water in it. You will notice that a thermometer placed in the water will fall slowly until it registers 32° F. At that point the water will begin to freeze and the temperature will remain unchanged until all the water has turned into ice. Thus you have learned that the freezing point of water is 32° F. Now if you take the test tube full of ice and plunge it into warm water, you will find that the thermometer does not begin to rise until all the ice has been melted. In other words, the freezing point and the melting point of water are the same.

A great many other substances, like water, may be frozen or changed into the solid form by cold, and melted into the liquid form by heat. You have often seen how butter melts on a hot day, and then solidifies or freezes again when it is put in the ice-box. And perhaps on a camping trip you have melted the solder off the spout of a coffee pot or a tin pail by letting it get too hot.

In the case of crystalline substances, such as ice and many metals, the melting and freezing points are the same. Non-crystalline substances, like wax, butter, glass, and iron, do not have a definite melting and freezing point. As heat is applied to them in their solid form they gradually soften, becoming first like a very thick liquid, and finally flow freely.

Most substances contract as they freeze, but you know from experience that this is not true of water. You have probably seen water pitchers and pipes burst by the pressure of the water as it freezes. This also explains why ice floats. A cubic foot of water becomes 1.09 cubic feet of ice, and therefore as the little ice crystals form in the water they rise to the top and unite to make a solid surface of ice. Another interesting result of this tendency of water to expand as it freezes is that pressure will lower its freezing point. You can prove this by suspending a heavy weight by a wire loop passing around a block of ice. The wire will slowly cut all the way through the ice, but the block will remain perfectly solid as before. That is because the pressure of the wire gradually melts the ice, which again freezes as soon as the wire has gone through and the pressure has been removed. So, too, in skating, the pressure of the skate blade on the ice melts a thin film of water which is very slippery. The same principle explains why glaciers—solid rivers of ice—can flow around corners.

In the experiment with which we began you learned that the temperature of melting ice did not change until all the ice had been changed into water. All the time the melting process is going on, the ice is absorbing heat from surrounding objects. It is on this principle that refrigerators work. This also explains the use of the *freezing mixture* of salt and ice we employed. Salt absorbs water very readily, even from ice, thereby melting it and forming a salt solution, or brine. But the freezing point of saturated brine is about −7° F., or 39 degrees below the freezing point of water. So, as the ice melts, it absorbs heat from the brine, which gets very cold. A freezing mixture of salt and ice is used in making ice-cream and artificial ice. The freezing point of a solution of calcium chloride is even lower, so this substance is also much used in refrigeration.

TABLE OF MELTING OR FREEZING POINTS

Alcohol	about —170°F.	Tin	450°F.
Mercury	—38	Lead	620
Water	+32	Silver	1760
Olive oil	50	Gold	1932
Paraffin	129	Copper	1981
Sulphur	239	Glass	about 1800 to 2500
Steel	about 2400 to 2500		

FRENCH AND INDIAN WAR. In 1754 began the last dramatic act in a series of contests between France and England for the possession of North America. Three wars between the two countries—King William's War (1689–97), Queen Anne's War (1701–13), and King George's War (1744–48)—had failed to bring a final settlement, and each side saw that it would have to throw more energy into the struggle if it would secure the great Ohio valley.

The French made the first move by beginning the building of a chain of forts extending from the St. Lawrence to the Mississippi. The land they were thus occupying was claimed by the colony Virginia under her "sea-to-sea" grant from the English crown, so the governor of the colony dispatched a small force under young George Washington to capture the French post, Fort Duquesne, on the present site of Pittsburgh, Pa. The expedition was unsuccessful and Washington had to surrender to superior forces.

The final war with France in America thus opened with bad luck for the English, and the next year (1755) was still more disastrous. General Braddock, who had been sent from England with a strong force of British regulars, was disastrously defeated and his army almost destroyed in his advance upon Fort Duquesne. He had not heeded the warnings of Washington, who knew how the French and Indians fought behind trees and rocks, but had marched into the wilderness with drums beating and banners flying. As was to have been expected, he was surprised and defeated by the enemy. He himself was mortally wounded, and his army would have been totally destroyed had it not been for Washington's skilful management.

By that time the struggle in America had become merely a part of a great conflict—called in European history the Seven Years' War—in which the grasping Frederick the Great of Prussia fought Austria with England's aid, and France was the ally of Austria. For France and England it was strictly a struggle for sea power and colonial rule, and it was fought in India, in Europe, and on the sea, as well as in North America. Success came to the British armies, due in a large measure to the able statesmanship of the prime minister, William Pitt. In a little while "the wind, from whatever quarter it blew, carried to England the tidings of battles won, fortresses taken, provinces added to the empire."

In America during the two years following Braddock's defeat the English colonies were hard pressed. The British offensive had failed and the Indian allies of the French plundered settlement after settlement along the border. The fall of Forts William Henry and Oswego on the New York frontier left that colony open to the ravages of the French. But in 1758 the tide turned. Pitt sent out a well-equipped army and fleet which, with the assistance of the colonial troops, captured Louisburg on Cape Breton Island, Fort Frontenac on Lake Ontario, and Fort Duquesne. The French line of forts was now broken and the next year Fort Niagara, Ticonderoga, Crown Point, and Quebec fell to the victorious British.

The most spectacular as well as the most important victory in North America was the capture of Quebec in 1759 (*see* Quebec, Canada; Wolfe, James). This practically sealed the fate of France in America, though the treaty of peace was not signed until 1763. France gave to England all of her vast possessions in Canada and east of the Mississippi River,—except New Orleans, which went to Spain along with the French territory west of the Mississippi. England also gained Florida from Spain (returned in 1783); thus the Union Jack floated over all the land east of the Mississippi and over Canada. In addition an end was put to French rivalry with the British in India. For America the war decided that the future United States should be English in speech and institutions and not French, largely Protestant in religion, and self-governing rather than despotically ruled.

The CLEAR *and* CHARMING LANGUAGE *of the* FRENCH

FRENCH LANGUAGE AND LITERATURE. The parent language of French, as of the other Romance languages, is Latin (*see* Romance Languages). Traces of this parentage are clearly to be seen in the great number of words that have come directly from Latin. Such words as *père* ("father") from the Latin *pater*, and *mère* ("mother") from the Latin *mater* clearly show this origin. Latin derivatives like these, indeed, constitute the bulk of the French vocabulary. French words, in the main, are simply Latin words which have been modified by natural development through the centuries.

Of the various dialects of Latin which sprang up over Europe during the early centuries of the Christian era, French was the first to be recognized as a separate language and the first to develop a literature. By the 9th century the dialect spoken in the north and center of what is now France, and that spoken in the south, had developed such marked differences that they were known by distinct names. The tongue (*langue*) of the south was called the *langue d'oc,* and that of the north the *langue d'oïl*, from the fact that the word for "yes" in the south was *oc* and in the north *oïl.*

MOLIÈRE
The Genius of French Comedy

Out of this northern tongue has developed the French language of today, a language which yields to none in clearness and richness. Of both the language and the literature which has sprung from it, the first and sharpest impression that the student receives is indicated in the famous remark, "That which is not clear is not French." More can be tucked away in a French sentence with less effort and less ambiguity than in any other modern tongue.

Fine Shades of Meaning in French

Not that in French it is necessary to express all thought bluntly and crudely. Black must be black and white, white, but there is much that is also gray; and for all fine variations of meaning, for delicate differences, French is the perfect tongue, because even in vague, cloudy matters, French must be clear. The very word *nuance,* by which the French indicate a subtle distinction, is appropriated by us in default of an English equivalent, just as our vocabulary has taken over many other French terms for the same reason.

But all this crystalline perfection, like every perfection, is bought at a price, and the price in this case is poetry, mystery, sentiment. For the French people, of whom the French language is the natural product and expression, are anything but mystical or sentimental. The advice of the philosopher Comte, "Feeling should always sway the mind," has no close grip upon the French—that logical, reasoning, realistic, methodizing race, formed so as always to see the point, often to their own inevitable boredom and dismay.

If only a little illusion, a little dull dreaminess, a little fear and doubtfulness could sometimes veil their penetrating and yet incomplete vision! Especially does this wish arise when one sees a bit of fluting Italian, or rich, pithy, bright English, translated into the uncompromising clearness of French. Yet to endow French more abundantly with "such stuff as dreams are made of" would be to rob it by just so much of its admirable lucidity.

The "Social Literature" of the French

This love for preciseness and clearness in literature is sharpened by the French social instinct. More than any other people, the French put the emphasis on society; less than any other do they interest themselves in the individual—his whims, his eccentricities, his special moods and traits. For this reason they have a "social literature," that is, a literature which concerns itself with matters of general social interest, rather than with the personal problems of the individual. Their writers remain within the illuminated circle of common experience, and seldom explore the uncommon, the mystic, the fantastic. Thus it happens that they are sometimes charged with being unoriginal and even superficial, especially by certain German critics.

With these charges in mind, Ferdinand Brunetière, one of the great modern French critics, has tartly replied: "The Frenchman piques himself on speaking clearly about matters which are sometimes profound, but the German seems to glorify himself too often on stating obscurely matters which are clear." The statement puts the French idea perfectly.

Brunetière is right in contending that in depth French literature compares favorably with any other. But it has a profundity of intelligence rather than of emotion, its fine distinctions are of thought rather than of feeling, its beauties are more often of form than of content, its triumphs are analytical and concrete rather than poetical or visionary.

Not a Language for Poetry

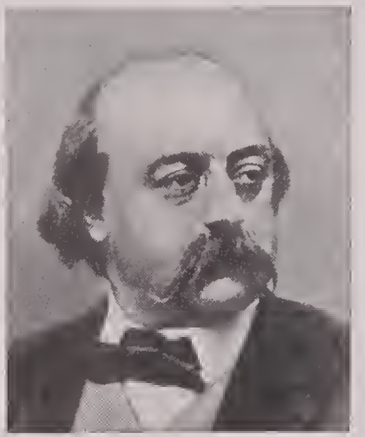
In view of such qualities as these in the French mind, it is therefore not surprising that French literature has gathered more laurels in prose than in poetry, whose very fabric is reverie, the intangible, the inscrutable. The French ardor for beauty of form has rendered their verse forms somewhat severe and rigid, though most graceful, elegant, and polished. Besides, no matter how clever the technique of the poet, the French language, with its nasal sounds and tapping monotone, is not an organ from which the sweetest music may be drawn. In any case,—

> Heard melodies are sweet, but those unheard
> Are sweeter.

and the unheard melodies of pure poetic fancy are somehow not a part of the French gift for delicate thinking rather than delicate feeling. Consequently if a reader is familiar with the subtle fairy singing of English poetry, the supple sensuous beauty of Italian, reminiscent of the arts of music and sculpture, or even the long, low rumble of German — that reader is often inclined to feel that French verses tinkle out in rhyme some very soulless and conventional thoughts.

VOLTAIRE
Master of Satire

But in tasting the delights of French prose there are no such secret protests to suppress. Here French clearness, French elegance, French insight, truly come into their own. Where English prose sprawls in abundance, the French is fine and shapely. Where the German and the Italian are often disposed to flounder in sentimentality, the Frenchman is keen, firm, unmuddled. Where the Russian turns morbidly in upon himself, the Frenchman is incorruptibly sound and sane, irrepressibly gay. In a world bitter with prejudice and flighty with wild dreams, the Frenchman seems able to see with clear eyes, to perceive with a cool heart. He is even exasperatingly right. If he does not sail among the stars, he does indeed "possess the mountain winds of truth."


FLAUBERT
Father of French Realism

Such have been the distinctions of French literature through a long history, so long and rich and complicated that any brief account of it becomes merely a roll-call of world-famous names.

DUMAS THE ELDER
King of Romancers

Beginnings of French Literature

But before we come to the first of these names, that of the chronicler Froissart, there is a vast mass of folk-epics in verse, of lyric poetry, of mystery and miracle plays, and of chronicles. (*See* Drama; Roland; Romance.) As in all other literatures verse preceded prose, and it was not until the 13th century that we find any considerable body of prose composition. This took the form of history, or chronicles, represented at their best by Froissart, the famous contemporary of Petrarch in Italy and Chaucer in England, who enriched and invigorated the French tongue much as Petrarch did Italian and Chaucer English. Soon after Froissart came Villon, the vagabond poet, whose hauntingly sweet and powerful lyrics stamp him as the greatest figure in French literature up to the time of the great men of the 16th century.

ROUSSEAU
Who Stirred Revolt

These creative geniuses —Rabelais, the jovial humorist and satirist; Montaigne, first and greatest of the modern essayists; Calvin, the luminous theologian; Ronsard, the elegant and original poet — these were the men who molded the French tongue into much the form it has today, expanding its resources, and making it the pliable, powerful vehicle of one of the world's greatest literatures. The French translation of the Bible, made in the 16th century, was a factor of weight in shaping the modern French language, in the same way that the development of English, German, and other European tongues was vitally influenced by the popular versions of the Scriptures.

During the closing years of the 16th and the opening years of the 17th century, while Shakespeare was liberating English poetry from its dreary formalism and artificiality, Malherbe, poet and critic, was busy in France framing a rigid form and cramping tradition for French poetry. In the 17th century came also the first of the *salons*, or fashionable literary gatherings of Paris, and the establishment of the French Academy, two powerful factors in the cultivation of taste and a sense of literary form. (*See* Academy, French.)

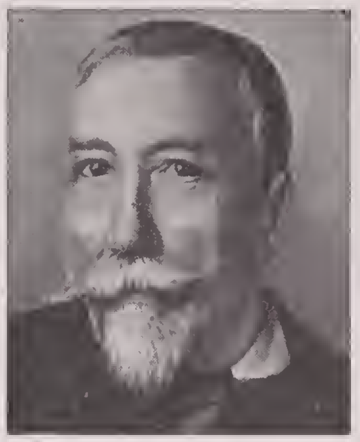
DE MAUPASSANT
Magician of the Short Story

In the Days of "the Grand Monarch"

One of the golden ages in French literature was the reign of Louis XIV (1638–1715), the monarch who declared, *L'Etat, c'est moi* ("I am the state"), and raised France to the position of the leading state in Europe. During his heyday flourished the three dramatic giants, Corneille, Racine, and Molière; the preachers Bossuet and

Fénelon; the theologian Pascal; the poet Boileau; the inimitable letter-writer Madame de Sévigné; the wits La Rochefoucauld and La Bruyère; and many another of that great generation.

Then came the amazing, mocking Voltaire—sharply rational, gay, capricious, witty, chatty, vindictive, generous, "the spoiled child of genius," who attacked superstitions and social abuses on every hand and turned off scores of fat volumes, now widely unread, which have been termed "a chaos of clear ideas." In his time he was "a founder of the future." His influence lay over all France until along came "the man from the Alps," Jean-Jacques Rousseau, a small fat Swiss, who, amid the skeptical Voltairean atmosphere, "invented a new fashion in feeling," the first "back to nature" movement. A vagabond and lackey, he voiced the ideas which produced the French Revolution and overthrew the existing social order; half-starved, cooped in a garret, he launched modern notions of hygiene and education.


"ANATOLE FRANCE"
Critic of Life and Letters

The French Revolution and its effect on literature is too complex for discussion here. Diderot, author of the first great encyclopedia, and Buffon, the philosophic naturalist, died before its horrors. De Saint-Pierre survived to produce his once highly popular 'Paul and Virginia'.

Many and lustrous are the names of the 19th and 20th centuries which witnessed the birth of romanticism and realism. There is the gentle skeptic Renan, author of the 'Life of Jesus' and 'Origins of Christianity'; Victor Hugo, poet and novelist, once a romantic child dreaming in his mother's great high-walled, neglected garden; Dumas the elder, whose novels are counted by the dozen, and Dumas the younger, whose plays are still favorites in many lands; the sentimental feminine genius who wrote under the name of "George Sand," with her tiny hands and great black eyes; the voluminous, marvelous Balzac, whose 'Comédie Humaine' (Human Comedy) ranks him as one of the world's most penetrating interpreters of the human soul; the faultless wizard of words, Flaubert, and his imperishable novel 'Madame Bovary'; Zola, guiding spirit of the naturalist school, with his laboratory in which he dissected the human race; Pierre Loti, magical prose-poet; the skeptical, ironic "Anatole France," who "despises men tenderly"; De Vigny and De Musset, the poets; Taine, Sainte-Beuve, Brunetière, Faguet, the critics; Maupassant, the unrivaled master of the short story; and many another sun-child living and dead. These it is who pass the torch of French literature to the present generation.

GREAT FIGURES IN FRENCH LITERATURE

Jean Froissart (1337–1410) — 'Chronicles'.
François Villon (1431– ?)—'Petit testament'; 'Grand Testament'.
Clément Marot (1495–1544)—'L'Adolescence'; 'Clémentine'; 'Blasons'; and other poems.
François Rabelais (1495–1553) — 'Gargantua'; 'Pantagruel'.
Pierre de Ronsard (1524–1585)—'Odes'.
Michel Montaigne (1533–1592) — 'Essays'
François de Malherbe (1555–1628)—Poems and translations.
Pierre Corneille (1606–1684) — 'Médée'; 'Le Cid'; 'Polyeucte'; 'Oedipe'.
François de la Rochefoucauld (1613–1680)—'Maximes'.
Jean de la Fontaine (1621–1695)—'Fables'.
Molière (Jean-Baptiste Poquelin) (1622–1673) — 'Tartuffe'; 'L'Avare' (The Miser); 'Le Bourgeois gentilhomme' (The Tradesman Turned Gentleman); 'Le Malade imaginaire' (The Imaginary Invalid).
Blaise Pascal (1623–1662)—'Pensées' (Thoughts).
Madame de Sévigné (1626–1696) — Letters.
Nicolas Boileau (1636–1711)—'Epîtres' (Epistles); 'L'Art poétique' (The Art of Poetry).
Jean Racine (1639–1699) — 'Thébaïde'; 'Andromaque'; 'Bérénice'; 'Iphigénie'; 'Phèdre'; 'Athalie'.
Jean de la Bruyère (1645–1696)—'Caractères'; 'Mémoires'.
François de Saligniac de la Mothe Fénelon (1651–1715)—'Télémaque'.
Voltaire (François Marie Arouet) (1694–1778) — 'La Henriade'; 'Zaïre'; 'Candide'; 'Siècle de Louis XIV'; 'Dictionnaire philosophique' (Philosophical Dictionary).
Georges-Louis le Clerc, Comte de Buffon (1707–1788)—'Histoire naturelle' (Natural History).
Jean-Jacques Rousseau (1712–1778) — 'La Nouvelle Héloïse'; 'Contrat social'; 'Émile'; 'Confessions'.
Denis Diderot (1713–1784)—'Encyclopédie'.
Bernardin de Saint-Pierre (1737–1814)—'Paul et Virginia'.
Madame de Staël (1766–1817)—'Delphine'; 'Corinne'.
Honoré de Balzac (1799–1850) — 'Les Chouans'; 'Eugénie Grandet'; 'La Père Goriot' (Old Goriot); 'La Cousine Bette' (Cousin Betty).
Victor Hugo (1802–1885) — 'Notre Dame de Paris'; 'Les Misérables'; 'Les Travailleurs de la mer' (Toilers of the Sea); 'Hernani'.
Alexandre Dumas, the elder (1803–1870) — 'Les Trois mousquetaires' (The Three Musketeers); 'Vingt ans après' (Twenty Years After); 'Monte Cristo'; 'Le Vicomte de Bragelonne'.
Charles-Augustin Sainte-Beuve (1804–1869)—'Causeries de Lundi' (Monday Chats).
"George Sand" (Baroness Dudevant, née Amandine Lucile Aurore Dupin) (1804–1876) — 'Jacques'; 'Consuelo'; 'La Mare au Diable' (The Devil's Pool).
Alfred de Musset (1810–1857)—'La Confession d'un enfant du siècle' (The Confession of a Child of the Age); 'La Nuit de Mai' (A Night of May).
Gustave Flaubert (1821–1880) — 'Bouvard et Pécuchet'; 'Madame Bovary'; 'Salammbô'.
Ernest Renan (1823–1892) — 'Histoire des origines du Christianisme' (History of the Origins of Christianity) which includes 'La Vie de Jésus' (Life of Jesus).
Alexandre Dumas, the younger (1824–1895)—'La Dame aux camélias' (The Lady of the Camellias).
Hippolyte Taine (1828–1893)—'Histoire de la littérature anglaise' (History of English Literature); 'Origines de la France contemporaine' (Origins of Contemporary France).
Émile Zola (1840–1902) — 'Rougon-Macquart' series, including 'L'Assommoir'; 'La Bête humaine'; 'L' Argent'; 'La Débâcle'; etc.

"Anatole France" (Jacques Anatole Thibault), (1844–)—'Le Crime de Sylvestre Bonnard' (The Crime of Sylvester Bonnard); 'Thaïs'; 'Les Opinions de M. Jerôme Coignard' (The Opinions of M. Jerome Coignard).

Émile Faguet (1847–1916)—Notes sur le théâtre contemporain (Notes on the Theater of Today).

Ferdinand Brunetière (1849–1906)—'Histoire de la littérature française classique' (History of Classical French Literature).

Guy de Maupassant (1850–1893) — 'La Ficelle' (The Piece of String); 'La Parure' (The Necklace); Une Vie (A Life).

Pierre Loti (Louis Marie Julien Viaud) (1850–)—'Le Pêcheur d'Islande' (The Iceland Fisherman); 'Madame Chrysanthème'.

The FIGHT *for* "LIBERTY, EQUALITY, FRATERNITY"

Here we see the Paris mob storming the Bastille, the old prison which represented royal oppression at its worst. The anniversary of the capture of the Bastille on July 14, 1789, in the beginning of the French Revolution, is still celebrated as the national holiday of France.

FRENCH REVOLUTION. If you visit France today you will see on all public buildings, even on churches, the three words, "Liberty, Equality, Fraternity." These words are the motto of the French Republic and were the watchword of the French Revolution. Of the three, "Equality"—the abolition of privilege—was to the Frenchman of 1789 the most important. For it he was ready to sacrifice political "Liberty" as he did when he accepted the yoke of Napoleon. For it "Fraternity," or brotherhood with all men, was allowed to remain a beautiful unfulfilled dream. But "Equality" before the law was achieved then and retained ever since.

The Frenchman had a reason for his passionate devotion to equality. Before 1789 inequality was the characteristic of the old régime. Inequalities met one at every turn and hampered all progress. The nobles and clergy, the "privileged orders," were exempted from such direct taxes as the *taille* and the chief burden fell upon the "Third Estate"—the peasants, artisans, merchants, professional men, etc. Even among these taxes were not equal. Some provinces were exempt from certain taxes, as the *gabelle* or salt tax. Then, too, the collection of certain taxes was done by contractors or tax farmers, and the tax-gatherer collected whatever he could. And woe to the man who seemed prosperous! As a result the peasant lived in a hovel and concealed his resources.

There were social and economic inequalities as well as political ones. The peasant groaned under the remnants of outgrown feudal dues, which were being collected with renewed vigor by the nobles in the

THE ROYAL PRISONERS IN THE TEMPLE

When Louis XVI was arrested by the Revolutionists he was lodged in the prison known as the Temple. Here we see him asleep on a couch. The Queen, Marie Antoinette, is by his side. Standing over the table is Marie Thérèse Charlotte, daughter of the King and Queen, and sitting by the footstool is the little Dauphin, the heir to the throne. Facing him is the King's sister. Beyond the doorway we catch a glimpse of the Revolutionary guards.

latter part of the 18th century. The rabbits might destroy the peasants' garden and the pigeons eat his grain, but he must not kill them, for they were protected for the lord's hunting. His fences were broken down and his crops trampled in the chase, but the peasant could claim no damages. On top of the dues to king and noble came the dues to the church. These and other obligations were often more irritating than burdensome; they were senseless and unreasonable to an age that was coming to believe through the writings of Voltaire and others in the rule of reason.

But were these conditions any worse in the latter part of the 18th century than they had been before? No, nor were they as bad in France as in some other parts of Europe; but now the people were beginning to think. The writers of the time—Montesquieu, Rousseau, Diderot, and the other "Encyclopedists"—stirred up thought and discontent. (*See* French Language and Literature).

At last the day of reckoning came. The funds in the national treasury had been exhausted by the costly wars of Louis XIV, and by the extravagance of him and his successors. The $250,000,000 that the American Revolution cost France was the last straw. Turgot and Necker, as ministers of finance, had tried to save the state from bankruptcy by cutting down the expenses of the court. But the court, led by the sprightly, frivolous, and extravagant queen, Marie Antoinette, would not listen to the word "economy." These ministers were dismissed and more accommodating ones took their place. Loans were tried, but in the end the foreign bankers refused to lend more money. Public opinion was deeply stirred by the Parlement of Paris, a judicial body which defied the king and refused to register new edicts of taxation.

In 1788 Louis XVI, as a last resort, called a meeting of the Estates-General (*see* Estates-General). The representatives of the three estates,—nobles, clergy, and common people,—all came to Versailles, not far from Paris, early in May 1789, armed with memorials (*cahiers*) demanding reforms. The grievances named differed, but all demanded a constitution.

With the meeting of the Estates-General on May 5, 1789, the Revolution began. The representatives of the Third Estate led the way. Some of the nobles and many of the clergy joined with them. They changed the name of the gathering from "Estates-General," which represented classes, to "National Assembly," which represented the people of France. When the king shut them out from their usual place of meeting, they took the famous "Oath of the Tennis Court" (June 20, 1789), pledging themselves not to separate until they had given France a constitution. When the king sent a messenger to remove them from their hall, the fiery Mirabeau cried out: "Go tell your master that we are here by the will of the people and that we will be removed only at the point of the bayonet." Such boldness was portentous.

Paris, 14 miles away, was alarmed by rumors of the gathering troops about Versailles. A Paris mob stormed and captured the old royal prison in Paris, called the Bastille, on July 14. When the king in Versailles was informed of what had taken place he exclaimed: "Why, this is a revolt!" "No, sire," was the reply, "it is a revolution." The incident was trivial, but its significance was beyond words. To the present time July 14, the date of the fall of the Bastille, is celebrated in France as the birthday of French liberty, as in America July 4 is celebrated.

After the fall of the Bastille a revolutionary committee of middle-class citizens governed Paris. A national guard composed mainly of citizens was organized and placed under the command of General Lafayette. Then the provinces followed the lead of Paris and formed revolutionary governments. The peasants in many places burned the castles of the lords, in order to destroy the papers which contained the records of the lords' manorial rights. "Spontaneous anarchy" prevailed in many country districts.

Nobles Renounce Their "Privileges"

A report of the peasant outbreaks made a wonderful impression on the Assembly. Some liberal nobles in that body set the example of renouncing their feudal rights. Amid the wildest enthusiasm, men weeping and embracing each other, one noble after another gave up some exclusive privilege, until finally a decree was passed which aimed at abolishing the feudal system entire. That wild night of Aug. 4, 1789, saw the beginning of Equality, though remnants of feudal dues kept the peasants uneasy until 1793.

But what had become of the constitution which the Assembly had promised to France? Work on it progressed piecemeal, and it was finally finished in 1791. Nobility was abolished. France was made a limited monarchy, with a one-house legislature. The immortal part of the document was the "Declaration of the Rights of Man." It included the following points:

1. All men were born free with equal rights.
2. All citizens have the right to take part in electing representatives to make the laws.
3. Every person shall be free to speak, write, or print his opinions provided he does not abuse this privilege.
4. The amount of taxes which a person is called upon to pay shall be based on the amount of wealth that he possesses.

The Declaration of the Rights of Man came to be regarded as the charter of democracy. The equality of all men in the eyes of the law is its essence. Property was inviolable, for the chief supporters of the new order held property or desired to hold it.

Overthrow of the Monarchy

If the king had possessed the courage—the moral backbone—and the vision to put himself at the head of the movement, France might be a monarchy today. But he was only a well-intentioned blunderer. At first he did promise to obey the constitution of 1791, which placed a narrow limit on his power. But then he listened to evil counselors. Many nobles had fled before the storm. These *émigrés*, as they were called, later headed by his own brothers, were in Germany, Austria, and Switzerland, appealing to the princes of Europe to stop the Revolution in France, and threatening a reign of bloodshed when they returned. The people of France, apparently with good reason, mistrusted the king and still more Marie Antoinette, "the Austrian woman." In October 1789, a disorderly mob of women and men had brought them—and the Assembly with them—from Versailles to Paris, that they might be more closely watched. The suspicions against them were changed into certainties for most of the people, in June 1791, when the king and queen with their children sought escape in flight. They were captured at Varennes, on the edge of the Argonne, just before they reached the border of France. They were brought back to Paris, and from that day the monarchy was doomed.

These events hastened the division of the revolutionists into two parties, the constitutional royalists and the democratic republicans. In September 1791 the king ratified the constitution and the new Legislative Assembly was strongly monarchial, but as the weakness of the government became more apparent, popular support shifted to the republicans.

On Aug. 10, 1792, a mob invaded the Tuileries, killed the guards, and forced the royal family to seek refuge in the hall of the Legislative Assembly. On Sept. 21, 1792, a decree was passed that "royalty is abolished in France," and a republic was proclaimed. Four months later Louis XVI was sent to the guillotine, a beheading machine named for the physician whose recommendation brought it into use.

The Clergy Oppose the Revolution

The overthrow of the monarchy was not entirely due to the weakness of the king. Affairs generally in France seemed to be going from bad to worse. The clergy and many devout Catholics had withdrawn their support from the Revolution because of the laws against the church. First of all, the church property had been taken by the state; this was a financial measure and generally approved. Then the "Civil Constitution of the Clergy" was drawn up, according to which all clergy from bishops to parish priests were to be elected and all must take an oath to support the government. The lower clergy drew back, and only four bishops took the oath. By a blunder the Assembly had divided the patriots, who had supported all changes up to this point. Others, especially merchants and tradesmen, were irritated by the paper money (*assignats*) with which the country was flooded and which soon became worthless. Royalist uprisings were occurring in some provinces, as in the Vendée. And at the same time that these dangers were threatening the Revolution within the country, Austria and Prussia, having finished the partition of Poland, were allied and hostile to the new order in France which threatened the old order everywhere in Europe. England was drawn into the war when the

THE ARISTOCRATS AND THE MOB IN THE STREETS OF PARIS

This picture illustrates a scene which was often repeated at the beginning of the Revolution. An aged member of the aristocracy, with his daughter on his arm, is being hooted and jeered by the maddened populace.

French revolutionary armies occupied the Austrian Netherlands (Belgium).

To guide the Revolution through this crisis a strong government was needed, and for this reason the people of France sacrificed liberty. A "Convention" was called to draw up a new constitution, and for three years (1792–1795) a committee of this assembly, known as the Committee of Public Safety, ruled France with an iron hand, while the constitution remained safely shut up in a box. The power of this committee did not come from the convention, but from the radical Jacobin club, whose members in the convention were known as the Mountain, from the high seats which they occupied in the hall of the Legislative Assembly (*see* Jacobins).

The men of power were Danton, Marat, and Robespierre, until the second was struck down by Charlotte Corday. Through agents and spies and "deputies on mission" the Great Committee spread its net over the whole of the country. By terror it maintained its position, and so the period is known as the Reign of Terror. By its means the royalist uprisings were sternly put down. Hundreds, even thousands, were sent to the guillotine. Marie Antoinette, Madame Roland, aristocrats and tradesmen, atheists like Hébert, finally even Danton himself (because he urged moderation), were executed, usually with no trial or only an imitation of one. Old institutions were changed. The worship of the Goddess of Reason supplanted religious services in the Paris churches. The calendar was made over, 1792 becoming the Year I, the first year of the French Republic, and the names of the months being changed.

But the Terror accomplished that for which it was intended. The Prussian-Austrian invaders had been turned back at Valmy (Sept. 20, 1792). Then the French armies carried the war into the lands of their enemies. "All governments are our enemies," cried an orator of the Convention, "all peoples are our friends." Belgium, Nice, and Savoy were added to France. Under Carnot, who by his efficiency gained the enviable title of "Organizer of Victory," 14 armies were put in the field. The cry had gone up for the natural frontiers of France, and the Revolution at war was going back to the policies of Louis XIV.

The Downfall of Robespierre

At length, however, the enemies of the Revolution at home and abroad seemed to be suppressed. Only Great Britain and Austria continued the war. The people were tired of the Terror, and when Robespierre showed no signs of stopping the bloodshed, the rest of the Convention took matters into their own hands. Danton had predicted, "Robespierre will follow me; I drag down Robespierre"; and finally Robespierre was arrested and sent to the guillotine (July 27, 1794). People then and afterwards blamed him for all the horrors of the Reign of Terror, but much of the blame, as well as the credit for it, belongs to others.

More moderate men now governed France. The Convention made another constitution—the third formed since 1789, and the second to be put into operation—and then prepared to dissolve. A mob of radicals led by conservatives protested against two-thirds of the new assemblies being drawn from the hated Convention. A young artillery officer, Napoleon Bonaparte, protected the new government. He was practically unknown at that time, but before long his history became the history of France. The new government, the Directory, proved unable to meet the problems within disorganized France. The glory of foreign victories which France won under it was due to Bonaparte. At length, Nov. 9, 1799, he overthrew the Directory. Under the cloak of a Consulate of three members he ruled France until 1804, when he threw off the cloak and became "Napoleon I, Emperor of the French." Liberty was gone. Napoleon himself declared: "Liberty is a necessity felt only by a not very numerous class. It can therefore be restricted with impunity. Equality on the other hand pleases the multitude." (*See* Napoleon I.)

Few events in history have so powerfully influenced the life of modern peoples as did the French Revolution, and on the whole that influence has been a permanent one for good. (*See also* articles on chief revolutionary leaders.)

FRICTION. Why is it easier to take the heavy groceries home on your sled than to drag the box in which the grocer has piled them? Because the smooth runners of the sled reduce the friction—the resistance—between the load and the ground.

Every effort to slide or roll one body over another is opposed by this resistance. It is caused by the unevenness of surface which we find even in the hardest and best polished objects if we examine them under the magnifying glass. The smoother the surface, the less the friction; hence in machines every effort is made to make the surfaces hard and smooth. Lubricants also lessen friction, and this is why automobiles and other machines are provided with elaborate oiling systems, without which the heat developed by friction would soon ruin them. Furthermore, rolling friction is less than sliding friction. This is why bicycle and automobile wheels and roller skates are provided with ball and roller bearings. Friction is also reduced by bearings made of "antifriction metals"—various soft alloys which are at the same time hard enough to hold their form against pressure (*see* Alloys).

Because friction means resistance, never power, we sometimes regard it as an unmitigated nuisance and a dead loss. Yet a frictionless world would be a strange place. It is friction that enables us to transmit power by pulleys and stop trains by brakes. Without friction, street-car and railroad wheels would spin around without advancing, as they sometimes do when there is ice on the rails, and a thousand and one other forms of effort would be fruitless. Friction in the wrong place, like sand in the bearings, is a dead loss; but in the physical world we would never get anywhere if we didn't encounter resistance —friction—on the way.

LITTLE TALKS ON GREAT THINGS

by Arthur Mee

FRIENDSHIP

ONE thing we all need on our journey through this world, whatever Time may bring to us. We come into the world alone; we pass out of it alone; but none of us can live his life alone. It is true that there are things in all our lives that God and we alone can know. It is true that there are times in all our lives when God alone can comfort us. It is true that the hour will come when the love of the dearest friend will fail us. But it is true that the love of a friend is the dearest thing in all the world, and that no man is so happy, and no man is so miserable, that he can scorn or reject it. In happiness and sorrow, too, the heart of a friend is our common need.

In the great things that make life worth while the hearts of true friends beat as one. In the journey from this world to the next comrades march together. Deep in the heart is sown the seed of friendship. When the daughter of a captive king bowed in submission before the closest friend of Alexander, thinking him the conqueror, she was much distressed by her mistake. "Do not distress yourself, madam," said the conqueror; "he, too, is Alexander." It was Alexander's beautiful tribute to a friend who was in possession of all Alexander's sympathies. Such friends are towers of strength to us. When our burden is greater than we can bear, they will share it with us. When our life is pleasant and easy, they will increase our happiness.

How Much Friendship May Mean

And the friend we choose in early life, whose life is linked with ours in the days when we are building up our interests, will grow dearer and dearer as the earth rolls through the heavens. The cares of life will knit us closer, and out of our sorrow, if sorrow should come, Time will weave a bond between us that Time itself can never break. Sorrow brings out friends as night brings out stars; and there are no friends truer than those who have shared our griefs, have known our fears, have helped sustain us in all the storms that come.

> The friends thou hast, and their adoption tried,
> Grapple them to thy soul with hoops of steel.

Shakespeare was right, but we should hold our friends by bonds more enduring than steel, the bond of sacrifice each for each, of perfect reliance upon each other's strength, of perfect trust in each other's love. Each will give to each the strengthening and uplifting things that all of us need in every hour of mortal life. In perplexity there will be counsel, in fear there will be courage, in all great enterprises there will be wise encouragement to splendid ends. And there will be always the steadying force of friendship, the restraint of wisdom, the love that would be sure that right is right.

The Friend as a Counselor

The wise love of a friend knows when to urge and when to check. It will not surrender great ends for smaller things. It will not determine great issues by small considerations. It will not oppose itself to natural circumstances and natural development, but will seek to guide them wisely and to grow with them. And we, on our part, should welcome the affection that bids us pause, that would be doubly sure before it sees us plunge into some great enterprise.

It is wise to know many people. It is wise to seek the company of those who are interested in the movement of the world. There is not much room in the world for dull people, and there is no room in your mind for ignorant people who will not learn. Pity them and teach them wisdom if you can, but we should seek the inspiration of those who feel that the world is real, that everything about us matters, and that the march of the world depends upon us, under the guiding hand of God. Every year, with expanding vision, we should widen the circle in which we move. It will be no narrow circle. We should shut our minds to nothing that has in it promise of a better future for anything under the sun.

And in this broadening circle, to which we should give of our life payment in abundance for what it gives to us, we may choose a closer circle of friends. Many we may know, but few we shall choose. They will come into our heart, and we shall open the gates of our soul to them. A Greek poet wrote:

> For Death, he taketh all away, but them he cannot take.

"He taketh all away," but the love your friend bore you, the sweet memory of it will live through Time after Death, with the stars, and the wind on the heath.

FRIG'ATE-BIRD. The "man-o'-war-bird," as the frigate-bird is sometimes called, is a genuine feathered airplane. Without seeming effort, it floats high in the air for hours at a time, ascending in spirals, or altering its course by so slight a change in the angle of its "planes" that the movement is not apparent.

There are but two species in this unusual family (the *Fregatidae*), both tropical birds. The larger of the two occurs in both hemispheres, mainly north of the Equator, and has been seen rarely as far north as Nova Scotia, and inland to Iowa. The other species appears in the Central Pacific and Indian oceans.

REMARKABLE BIRD OF THE SEA

This picture will help to fix in your mind many striking characteristics of the Frigate-Bird—his huge wings, his forked tail, his curious air sac, his big beak, his ridiculous little legs. The lady Frigate-Bird you see upon her nest.

Frigate-birds have long, stout, hooked bills; the tail is extremely long and deeply forked; and the bones are of a pneumatic structure that makes the body of the bird lighter than that of any other bird of equal wing size. When spread, the long narrow wings measure ten feet from tip to tip. But they have very small legs and are almost helpless on land. Perhaps the most striking characteristic is the air sac of the male, which lies along the throat and, when fully distended, reaches outward to the end of the long bill and downward so as to obscure the breast; it then looks like a great red balloon. When deflated the sac is invisible beneath the plumage of the neck. The feathers are black; the female birds, however, have light under-feathers.

These birds nest mainly in colonies on tropical islands. The nest of sticks, placed on rocks or low bushes, contains one or two hen-like white eggs. The birds feed on fish, which they steal from gulls, gannets, and terns. In robbing gannets, frigate-birds display a good deal of strategy. Hiding behind coconut trees they sail out to meet the gannets returning with their fish in the evening. In case the unfortunate fishers do not respond at once to the demands of these feathered pirates, the latter seize them by the tail and give them a vigorous shake. Then down go the fish from their beaks and down swoop the frigate-birds after them. Yet, curiously enough, the birds roost near each other at night as if they were the best of friends.

On islands where they are often disturbed, the frigate-birds build their nests on the edges of inaccessible cliffs, but where they are not molested they build on the ground. It is about the beginning of January that the males begin the development of that remarkable pouch. A dozen or more will sit on a tree with outstretched and drooping wings, with the great scarlet pouch blown up like a boy's red balloon. When a female frigate-bird approaches the tree, it is considered the proper form to cry "*wow-wow-wow-wow*" and clatter the beaks like castanets, at the same time shaking the wings. This performance continues throughout the mating season, which extends from January until April. Scientific name, *Fregata aquila*.

FROEBEL (*frö'bĕl*), FRIEDRICH WILHELM (1782–1852). It was not until Froebel, the great German educator, was 50 years old that he found his real life-work, the kindergarten, and yet the various occupations to which he gave his youth and manhood were, in a sense, a necessary preparation for it. His uncongenial boyhood home turned his thoughts early to lonesome neglected children. The years which he spent at his uncle's house as apprentice to a forester must have filled his heart early with the love of nature which colors all his thinking. Surveying, clerking, architecture, studying at the University of Jena, gave him the various sorts of experience which helped him to understand all kinds of people.

In his early twenties Froebel was engaged to teach in Herr Gruner's school at Frankfort. He realized immediately that he loved the work, being, as someone has said, "a teacher by the grace of God." He said, in spite of his success, that there was much for him to learn and so he spent several years studying with Pestalozzi, the Swiss educator, and at several German universities. He even volunteered as a soldier against Napoleon, so that he might never ask his pupils to do a thing which he had not done himself.

For two years after the Peace of Paris in 1815 he was curator of crystals at the museum of the University of Berlin. That life, however, did not content him, and in 1816 he established his first school. It was not until 1835 that he founded the sort of school that has had so wide an influence on education all over the world. That was the kindergarten—"children's-garden," in English—a school for children between the ages of four and six. The great idea which he developed in his books and in his schools was that children must not be taught by rule, but according to their natural instincts and activities. The kindergarten bases its teachings on play because that is what little children do naturally.

But Froebel did not live to see his idea fully accepted. The Prussian government abolished kindergartens in 1851 because the authorities considered them socialistic. Froebel died the next year considering his life a failure. But, as is often the case with men of new ideas, the teaching which he had thought out lived on. Some of his opinions have been discarded, but his work has still a great influence on education and the establishment of kindergartens all over the world. (*See* Kindergarten.)

All About FROGS *and* POLLIWOGS

The Story of the Little Fish-like Creature that Puts on Four Legs, Absorbs His Tail, Exchanges His Gills for Lungs, and Learns to Live on Land as Well as in the Water

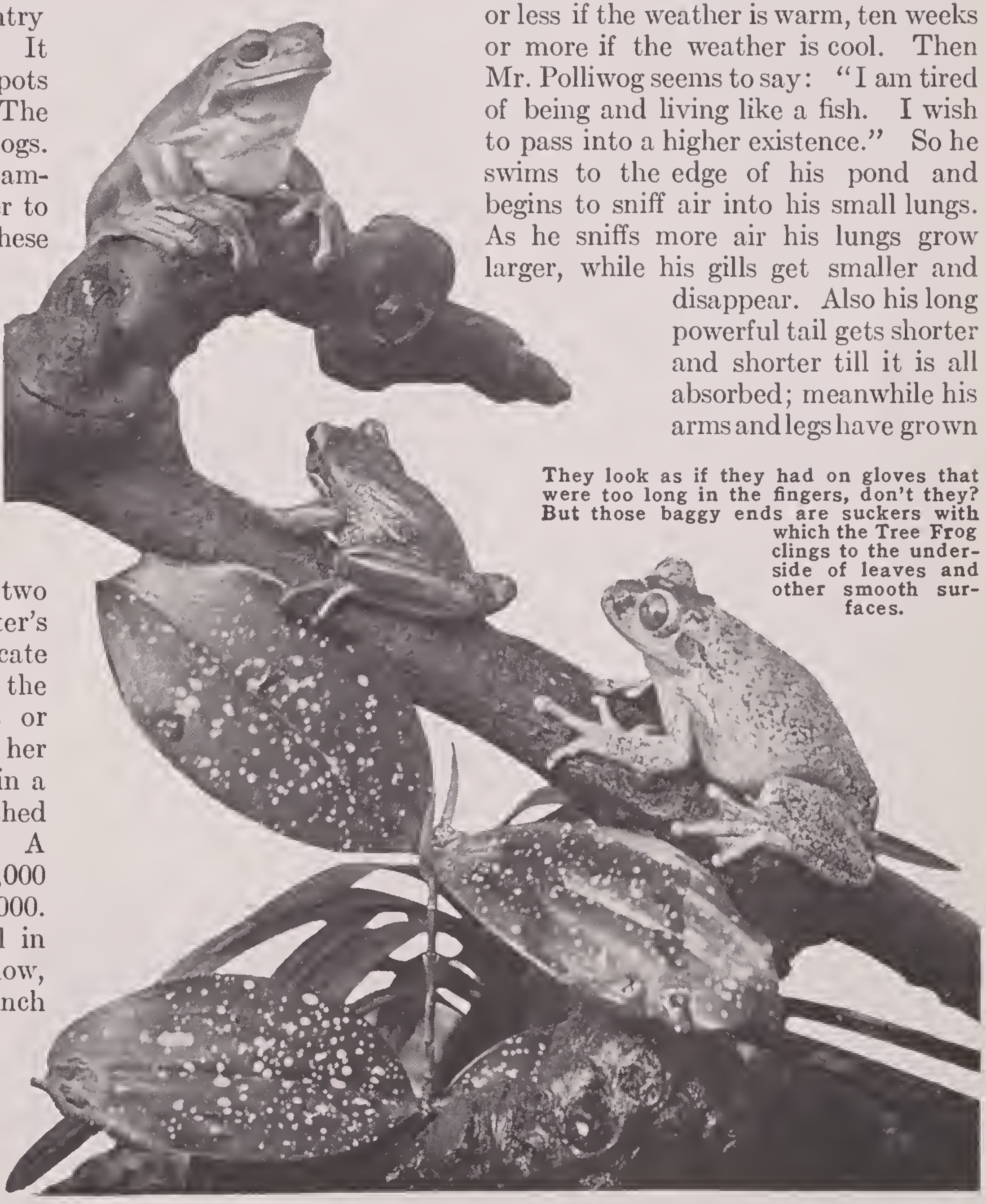
FROG. Frogs are first cousins to toads and second cousins to salamanders. They all belong to the class of backboned animals known as Amphibia, which means that they are prepared to live both in water and on land. They all have in common a moist clammy skin without scales; all lay their eggs in water, in jelly-like masses; and all pass through a tadpole or polliwog stage.

Frogs of one or more kinds are found in all parts of the United States except where it is very hot and dry. The most widely distributed and most abundant is the very common "leopard frog," which is found throughout the country east of the Rocky Mountains. It has irregular rows of black spots all over its back and legs. The under side is light, as in all frogs. We may follow its life as an example of frogs in general, in order to learn many things about these fascinating creatures.

Let us begin at the beginning, and look for the eggs in water a foot or less in depth; in the oozy quiet places at the edges of ponds and small lakes. Here, in March in the south but in April and May farther north, both males and females gather for the annual egg-laying two or three weeks after the winter's ice has thawed. We may locate them by the low croaks of the males. Usually in the night or early morning the female lays her yearly batch of eggs, inclosed in a single mass of jelly and attached to a pond plant of some kind. A small frog may lay 2,000 to 3,000 eggs, a large one 6,000 to 8,000. Each egg is perfectly spherical in shape, black above, light below, and about one-sixteenth of an inch in diameter. When first laid the mass is as large as a teacup, but it swells up with water and has increased in size several times by the time the eggs hatch. It is hard to believe that so large a mass was all laid by a single mother frog.

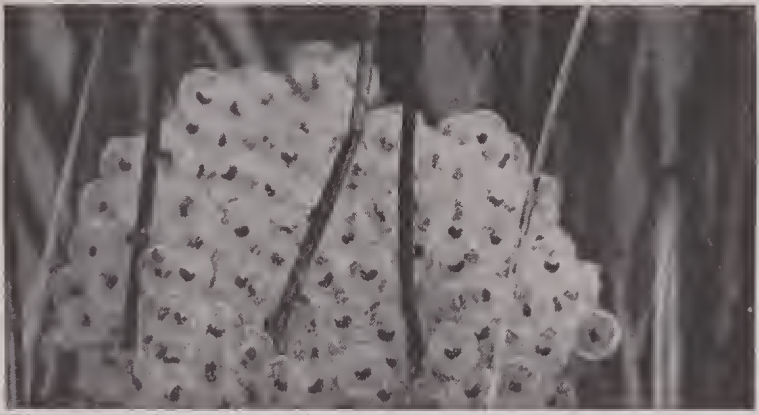
Let us follow one of the eggs. It hatches out into a short stumpy polliwog. A few days later it has grown gills for breathing, a tail for swimming, and a pair of horny beaks, with which it nips off bits of pond vegetation and gobbles up great amounts of mud for the small amount of food it contains. The tadpole is really very much like a fish, with many fishlike characteristics.

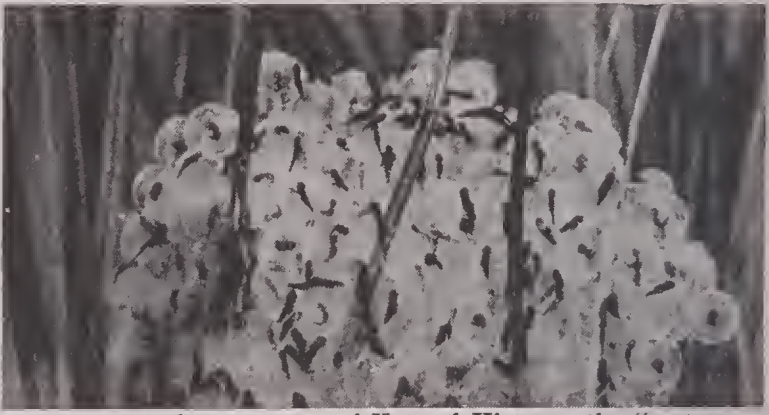
So it lives and grows till it is a powerful full-grown tadpole, three or four inches long—in eight weeks or less if the weather is warm, ten weeks or more if the weather is cool. Then Mr. Polliwog seems to say: "I am tired of being and living like a fish. I wish to pass into a higher existence." So he swims to the edge of his pond and begins to sniff air into his small lungs. As he sniffs more air his lungs grow larger, while his gills get smaller and disappear. Also his long powerful tail gets shorter and shorter till it is all absorbed; meanwhile his arms and legs have grown



They look as if they had on gloves that were too long in the fingers, don't they? But those baggy ends are suckers with which the Tree Frog clings to the underside of leaves and other smooth surfaces.

THE LIFE OF A FROG FROM THE JELLY EGGS TO THE JUMPING STAGE





The seven pictures on this page are seven chapters in one of the strangest of the romances of Natural History—the "metamorphosis" of a Frog. Beginning as masses of jelly-like eggs attached to pond plants, as shown at the left, the little Polliwogs soon wriggle out into the world, as we see in the picture on the right.

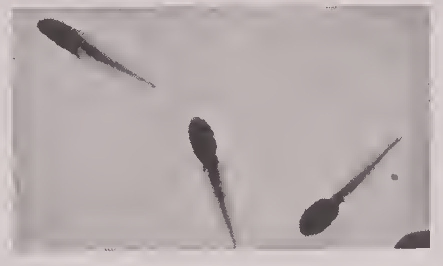
and he is prepared for his life on land. Because of the absorption of the tail, it has been said that a tadpole is "a bottle baby, and cannot lose his bottle until he is through with it."

Many other very interesting changes take place in Mr. Polliwog, inside and out, during his wonderful "metamorphosis" into a frog. One of the most striking is in the intestine. When he is a polliwog he seems to say, "I have to gobble up loads of coarse stuff for food, and so I need a very long intestine"—two or three feet of it. But as he becomes a small frog he seems to say, "After I become a frog I'll have insects to eat, and worms, and other nutritious diet and shall need only a short intestine"—and so it shortens to two inches. How long does it take for all of these wonderful changes to occur? Only a few days—if the weather is warm, a week or less; if cool, two weeks or more.

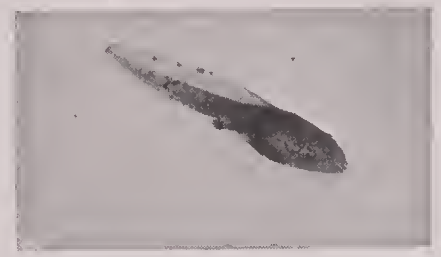
Master (or Miss) Frog is still only as large as the end joint of a man's middle finger, but it has all of the "earmarks" of a grown-up frog—a smooth moist skin, with spots; large prominent eyes of great beauty; smooth drumheads of the ears back of the eyes; a mouth with a wide gape; a long tongue, loose behind, and capable of being flipped out with great rapidity and precision to catch its prey; small arms and hands with four fingers each; large powerful legs and feet with five long webbed toes.

Let us follow Mr. Frog for the rest of his life. He lives most of the time among vegetation in deep marshy places, but always near the water. From time to time he may "plunk" into it to escape his enemies. He absorbs water through his skin and stores it in his bladder, to keep his body moist. When the autumn frosts come he must bury himself in oozy places to "hibernate" or pass his long winter sleep. And in the spring the eggs are laid by the female in the water again.

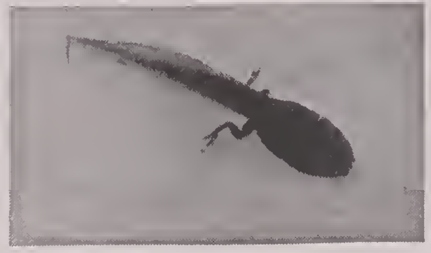
The frog feeds and grows through his first summer, then passes his first winter sleep. The second summer he feeds and grows again, and sleeps again the next winter. He comes out the next spring for the first egg-laying, but he is not full grown till he is about five years or more old. After that how long does he live? No one knows very accurately, but a good many years—perhaps 10 or 20 or 40, if he is lucky enough to escape so long from freezing and drying, and from the snakes and herons and muskrats, and all the other enemies that destroy small frogs and big ones. From the beginning of his life to its end the frog is a wonderfully fascinating creature, and likewise a very useful one. For he captures and gets rid of thousands of mosquitoes and other insects of many kinds that pester man and other animals. Besides, frogs' legs are regarded as a great delicacy for eating. And many thousands, almost millions, of frogs are used yearly in medical and biological laboratories in all parts of the world for all sorts of experiments. Scientific men sometimes say that it seems as if frogs had been made for scientific uses. Recently a law has been passed in Minnesota



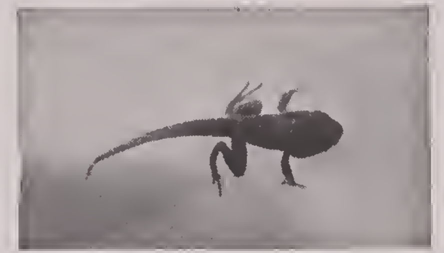
Now the heads have grown larger and the tails longer.



Mr. Polliwog begins to sprout his two hind legs.



Here these feet have already become decidedly froglike.



And now along come a pair of front legs, and he has evidently made up his mind to be a Frog.

At last the change is complete, the tail has disappeared, and here he sits as if for inspection.

making it illegal to catch frogs for market during their breeding season, in March and April.

Different Kinds of Frogs

There are about three dozen kinds of frogs in this country, differing from the "leopard frog" mostly in mode of life, size, and the spotting of the skin. Of course we all know the tiny "peepers," not so large as the end joint of a small finger, with their shrill songs about the ponds as soon as the ice is out in the spring. Their tiny eggs are laid at very much the same times and places as those of the leopard frog. And the "tree-frog" is also interesting, with its rather doleful song, and its wonderful changes of color—light ashy gray, brown, bright green—in close imitations of its surroundings. Its eggs are laid in late spring. At the other extreme is the great southern "bullfrog," as large as a double fist, with its hoarse drumming sound that can be heard for a half-mile, from which it gets its name. It passes its first winter as a tadpole, as does also the smaller "green frog."

The frogs west of the Rocky Mountains belong to different species from those east of the Rockies but are not very unlike them. In tropical regions some of the frogs lay their eggs in damp places, and the young are liberated as small frogs.

Frogs and toads belong to the order *Salientia*, of the class *Amphibia*. Scientific name of the leopard frog, *Rana pipiens;* of green frog, *Rana clamitans;* of bullfrog, *Rana catesbiana;* of "peeper," *Hyla pickeringii;* of tree frog, *Hyla versicolor*. (*See also* Toad.)

FROISSART (*frwä-sär'*), **JEAN** (1337–1410?). As a historian and poet of the Middle Ages, Froissart evidently felt, long before Shakespeare lived to say it, that "all the world's a stage." He lived at a time when that stage was particularly lively, when the curtain rose on great castles and tall cathedrals, when armored knights on strong war horses trod the earth, and chivalry and poetry were in the air.

Froissart gloried in this life, in its gorgeous pictures and heroic deeds. He sang of it in poetic ballads, and he wrote a history, his famous 'Chronicles', dealing with events from 1326 to 1400, which gives us our most vivid accounts of the superstitious, romantic, warring world of that time. It is from him especially that we get our account of the Hundred Years' War, with its picturesque battles of Crécy and Poitiers. Often his stories contradict one another, and there is no doubt that his imagination filled in the barren spots where facts were wanting. He never let uncertainty spoil a good story and his sympathies are always with the lordly knights rather than the humble townsmen and peasants. But his 'Chronicles' are faithful to the spirit and pageantry of those days, even though he was sometimes mistaken about just what happened.

To collect the stories which he tells us, he wandered on horseback, a greyhound trotting behind, through many lands. The queen of England, wife of Edward III, the Scottish King David Bruce and the Earl of Douglas, the Duke of Clarence in Italy, the Duke of Brabant and the Comte de Blois were all among his friends and patrons. During his travels he talked with lords and knights, squires and heralds, and jotted down from their unreliable lips tales of the court and the battlefield. In his youth he was educated for the church, and in his old age the Comte de Blois made him canon of Chimay; and there was ended the adventurous life of this "knight errant of history." (*See* Hundred Years' War.)

FRONTENAC (*frôṅ'tĭ-näk*), **COUNT LOUIS DE** (1620–1698). The "Savior of New France" is the title often given to this French nobleman, because it was his efforts that saved the French settlers in the St. Lawrence valley from being wiped out by the Indians. He thus shares with Champlain and La Salle the glory of establishing French power in North America.

Frontenac belonged to the nobility of France, and had for his godfather King Louis XIII, whose name he bore. The change from the splendid court of France to the wilderness of Canada, to which Frontenac was sent as governor in 1672, was a tremendous one, but he had a passionate love for the soldier's life. As a boy of 15 he had served in Holland, and in the 37 years which had passed since then he had frequently fought valiantly for his king in Italy, Flanders, and Germany.

Furthermore Frontenac liked to rule, and it was a vast domain which was given to him to govern. He showed his administrative wisdom by attempting to introduce into Canada an assembly of nobles, clergy, and common people, like the Estates-General which had met in France in former times. He likewise tried to give Quebec some measure of local self-government by calling town meetings twice a year to elect aldermen and to discuss public business. But while he was trying to introduce these reforms in the New World, the king was busily engaged in suppressing the same institutions in France, and so Frontenac's efforts did not meet with royal approval.

The governor also antagonized many of the leaders in the colony by his imperious and haughty disposition. The traders, however, were friendly, because he crushed the Iroquois Indians, the persistent enemies of the French. The story of his struggles and achievements is told in Parkman's 'Count Frontenac and New France' and Le Sueur's 'Count Frontenac'. Because of difficulties with the Jesuits and others, he was recalled to France in 1692. When the colony was involved in a new war between France and England (1689) he was sent back as governor. This time he not merely defended Canada against English attacks, but so lessened the power of the Iroquois that they never again became a serious danger to the French settlements.

FROST. When you wake up on a fine cold winter morning and find your window-pane covered with wonderful landscapes, flowers, or fairy lace, you know that Jack Frost had been there in the night. He paid visits to the garden and lawn much earlier. In the autumn you found grass, shrubs, and trees silvered

FOUR MASTERPIECES BY THE ARTIST, JACK FROST

Nothing that human artists and craftsmen can do quite equals the infinite skill of Jack Frost in working out his delicate artistry. A whole book could be filled with different examples of frost traceries on window panes alone, and no two would be exactly alike. In this group the first picture shows what are known as "ice-flowers," star-shaped crystals imbedded in masses of ice. The second and third show frost formations on grasses in the field, and the fourth on grasses in a shallow stream. These designs are most beautiful shortly after sunrise; then in a few hours, under the sun's rays, they vanish like some fairy vision.

with frost after some cold, still night. If the conditions were right, little twigs bore a delicate fur of fine white frost. Then, when the sun rose, the chrysanthemums and hollyhocks drooped and withered.

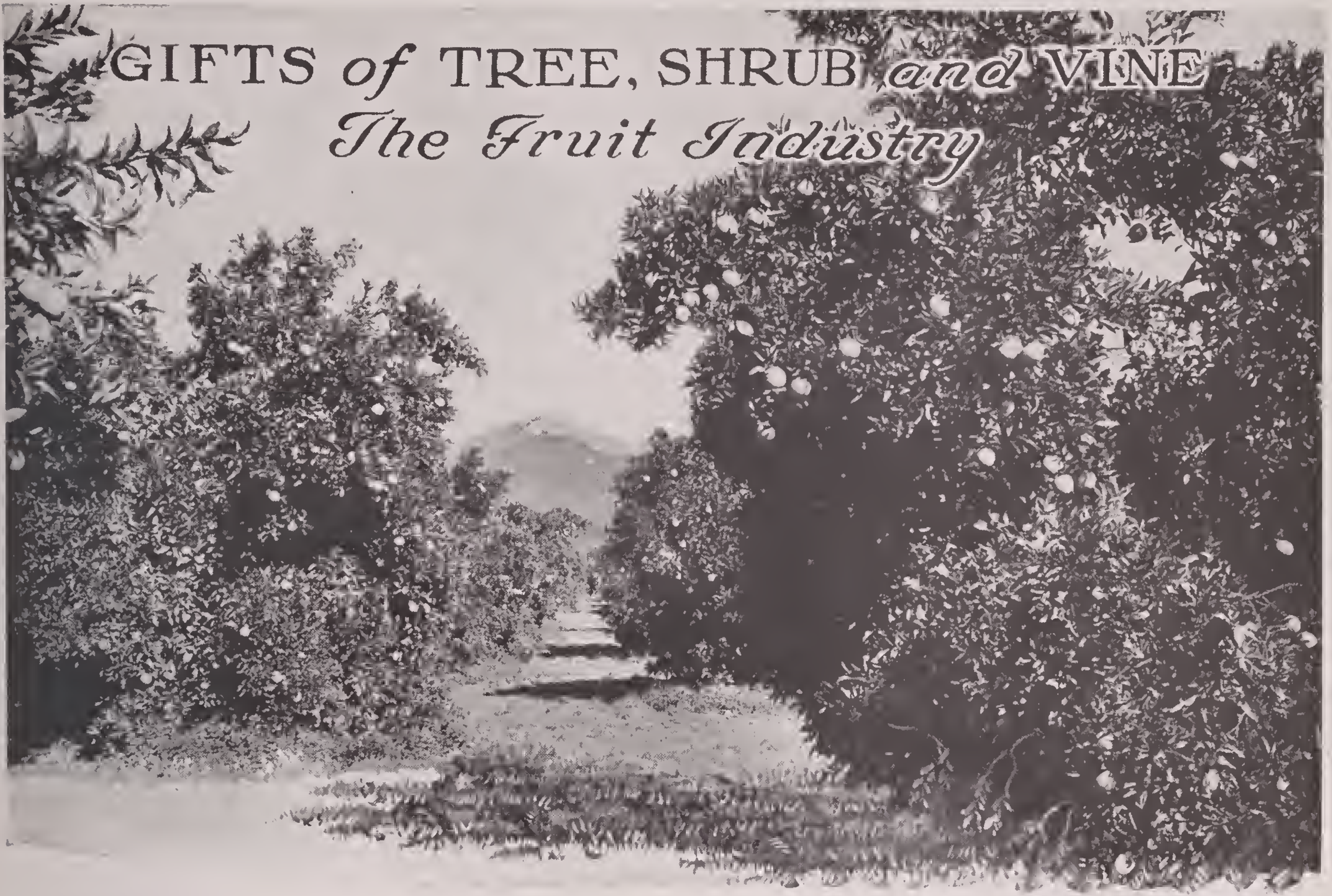
What we have been talking about is "window frost," "white frost," or "hoar frost"—really water crystals, essentially like snow and ice. When the air is ready to form dew, that is, when it is calm and saturated with moisture or water vapor, then, if the temperature falls below freezing, frost or crystallized water is formed instead of dew or liquid water. If the air in a room is dry, frost will not form on the windowpanes no matter how cold it is; but boil a kettle of water in the room or bring a number of people in to fill the air with moisture-laden breath, and at once frost patterns will form on the glass provided it remains cold. Stillness of the air is also essential; you never saw frost after a windy night.

Sometimes the air is too dry or too windy for hoar frost; but the temperature falls below 32° F. and plants freeze at night and turn black when the sun melts the sap in the morning. This is what is known as a "black frost," though it might more properly be called a freeze. We commonly apply the name "frost," however, rather loosely both to the crystalline deposits of water and to the temperature which produces them.

Frosts are matters of particular concern to farmers because early autumn frosts might kill crops before harvests, and late spring frosts often kill planted crops and fruit buds. Various methods of protection have been devised. A light cloth canopy over plants prevents radiation of their heat into the air, and reflects back the heat from the soil. On still nights a fire which produces an abundance of smoke is useful. The smoke spreads in all directions and acts in the same way as the cloth canopy.

It is a matter of common knowledge that crops on hillsides often escape frost while crops in the adjacent valley are destroyed. This is not caused, however, by cold air "flowing down hill" into the valley, as commonly supposed. All the air cools and becomes denser and heavier after nightfall. The air in the valley, since it is already as low as it can get, remains in position and becomes colder and colder. The air on the hillsides falls a little because of its weight, and then "slides out" over the surface of the bottom air, as though over the surface of a lake, and warmer air from above settles into its place. Thus the temperatures on the hillside are kept higher than in the valley.

GIFTS of TREE, SHRUB and VINE
The Fruit Industry



Here are "golden apples of the Hesperides"—that is to say, Oranges—one of the most beautiful and delicious of all the fruits of the earth, as they are to be seen in the orange groves near Pasadena, California.

FRUITS AND FRUIT GROWING. The fruits that we enjoy today in all their wonderful variety of choice flavors and attractive colors represent nature's gracious rewards for cultivation rather than her free gifts to man. Primitive man took what wild fruit the trees, shrubs, and vines had to offer, without bestowing any care in return. Practically every fruit of the temperate zone and many of the desirable fruits of the tropics grow today in North America but the American Indians had only a few varieties of crab-apples, and berries such as strawberries, mulberries, and huckleberries. Our modern fruit industry chiefly depends on the fruits which the white settlers brought from their homelands across the water—fruits that had been cultivated for hundreds and even thousands of years in Europe and Asia.

Fruits with tempting flavors highly developed, seedless, thin-skinned, and oversized fruit, and fruit stalks without spines or thorns—these are some of the marvelous changes due to man's experiments in fruit growing (*see* Burbank, Luther). Such results have been obtained in some cases by cross-fertilization between two species so that the desirable qualities of both are combined in one hybrid.

However, the seeds of hybrids and other choice varieties obtained by careful selection and cultivation will not usually run "true to type." Trees and shrubs grown from such seeds tend to go back to the form and habits of their wild ancestors. To overcome this difficulty, the process of grafting is used, by which a bud or twig of the choice variety of tree or shrub is made to grow from the roots or stem of a common or even a wild member of the same tribe. The bud or twig, called the "scion," is inserted in a cleft cut in the "stock plant," and the joint is then dressed and bandaged to protect it from the air. If this "plant surgery" is properly performed, the two will knit together and grow like broken bones when they are set by a physician. And the resulting "new" tree will bear the same fruit as its parent stock.

Great numbers of fruit seedlings are raised to provide the stocks on which choice cuttings are grafted in special nurseries. The combined stock and scion are then transplanted to the orchards.

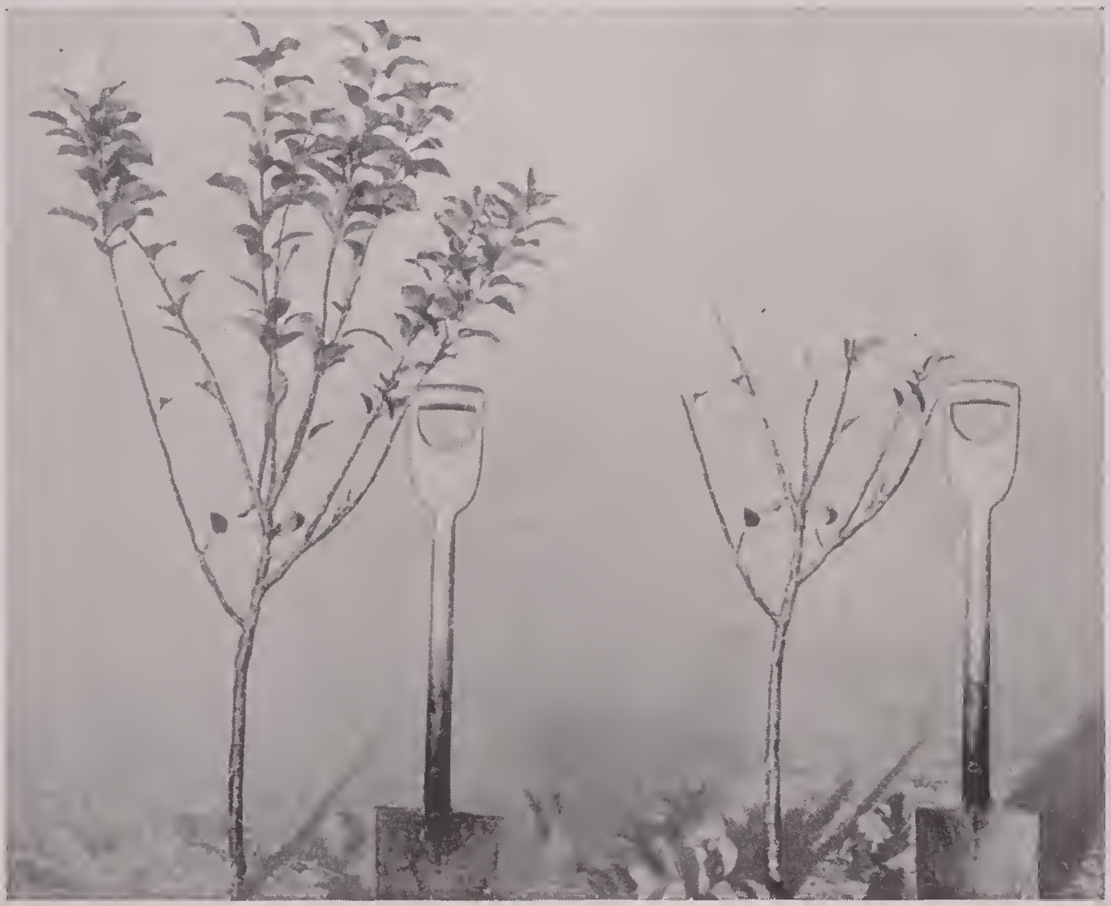
Great changes in the fruit industry have come about by refrigeration and rapid transportation (*see* Refrigeration). Previously apples were practically the only fresh fruit enjoyed in winter. Perishable fruit could be eaten fresh only in season and in the locality where grown. Now the fruits of the South are regularly shipped to the North when fruits there are not in season, and fruits of many kinds are kept in cold storage warehouses for winter use. Many American fruits are shipped to England and other countries, and in return various native fruits are brought from practically every country of the globe—melons from southern France, peaches grown in the hothouses of Belgium, and peaches, plums, and other fruits from South Africa. Fresh apples, lemons, bananas, and oranges are supplied throughout the year, while pears, strawberries, grapes, and peaches which a half-century ago were enjoyed only for a few weeks are now on the market many months. During the boyhood days of men now in middle age, bananas were a curiosity to be had only in large cities. They have become a year-round standby. So too our chief markets are now receiving the *avocado* or alligator pear, a fruit with smooth rich pulp which when ripe has a nutlike flavor, is very rich in fats, and can be spread on bread like butter; the mango (*see* Mango), and the sapodilla, the apple-shaped fruit of a large evergreen tree which also supplies the chicle used in making chewing gum.

PLANTING A FRUIT TREE

Young trees should be transplanted an inch lower than they were planted in the nursery. A board is used to gage the depth of the planting.

There are many other tropical fruits, however, which are as yet little known except in the areas where they grow or as they come to us as preserves of some kind. Such fruits as the *papaw* of the tropics, a fruit resembling a small cantalope very different from the banana-shaped fruit of the common American papaw; the *tamarind*, which has long brown-shelled pods containing a brown acid pulp used in making cooling drinks and marketed in sweet preserves; the *loquat*, a Chinese or Japanese fruit now cultivated in the Gulf States and resembling a yellow plum; the *cashew apple*, the fine-flavored fleshy stalk on which is borne the nut of the tree; *guava*, represented by the two varieties, red and white, one shaped like an apple and the other like a pear, the pleasantly acid pulp of which is made into guava jelly; *mangosteen*, a reddish brown fruit about the size of an apple and having white juicy pulp of delicate sweet and acid flavor; *cherimoyer* or custard apple, the small heart-shaped pulpy fruit of a little tree grown in Colombia or Peru; and the *star apple*, a West Indian fruit like an apple in size and appearance with a star-shaped center formed by the seed cells.

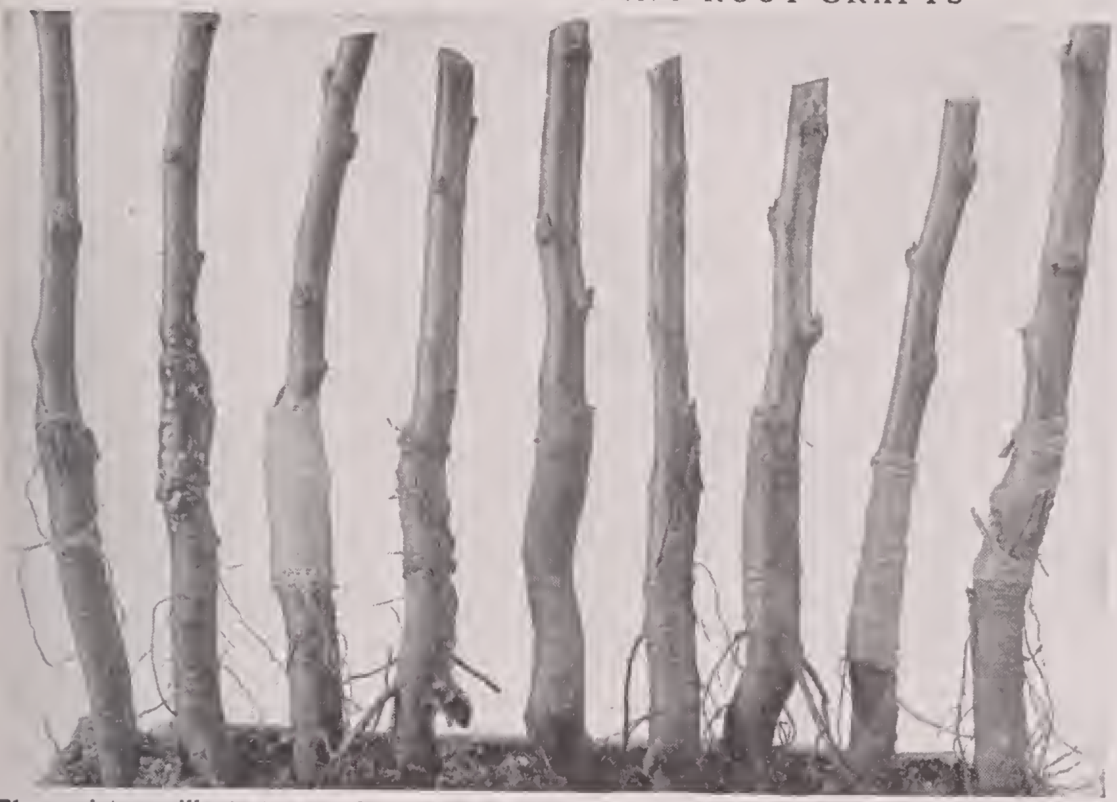
A YOUNG TREE BEFORE AND AFTER PRUNING



When trees are brought from the nursery, the tops should be cut back so that there will be a balance between the amount of top and the amount of roots remaining. Unless this is done transplanted trees usually do not get on well.

While we still have the small fruit garden, and the farm orchard of 50 or more trees, this wider distribution of fruits has developed commercial orchards spreading out over thousands of acres of irrigated land. Thousands of workers are employed on the large projects in picking, sorting or grading, packing, and marketing the fruit. The workers must know their trade and work with nimble fingers. The fruit, picked just at the right time, which is before it is ripe, is carefully handled, wrapped, and closely packed to prevent bruising which might cause the fruit to rot before reaching the market. In most of the fruit areas the grading, shipping, and marketing, even

THE BEST WAY OF WRAPPING ROOT GRAFTS



These pictures illustrate experiments made by the Department of Agriculture at Washington to determine the best method of wrapping root grafts. The materials used were cloth, rubber, waxed paper, plain thread, and waxed thread. One you see was left unwrapped and in another the union was waxed without wrapping. The conclusion from the experiments was that cloth is the best wrapping to use.

the advertising, is carried on by effective coöperative organizations. They strictly supervise the quality so that the reputation may be maintained and so enable them to market the product at the best rates for the producer.

Uncle Sam the Greatest of Fruit-Growers

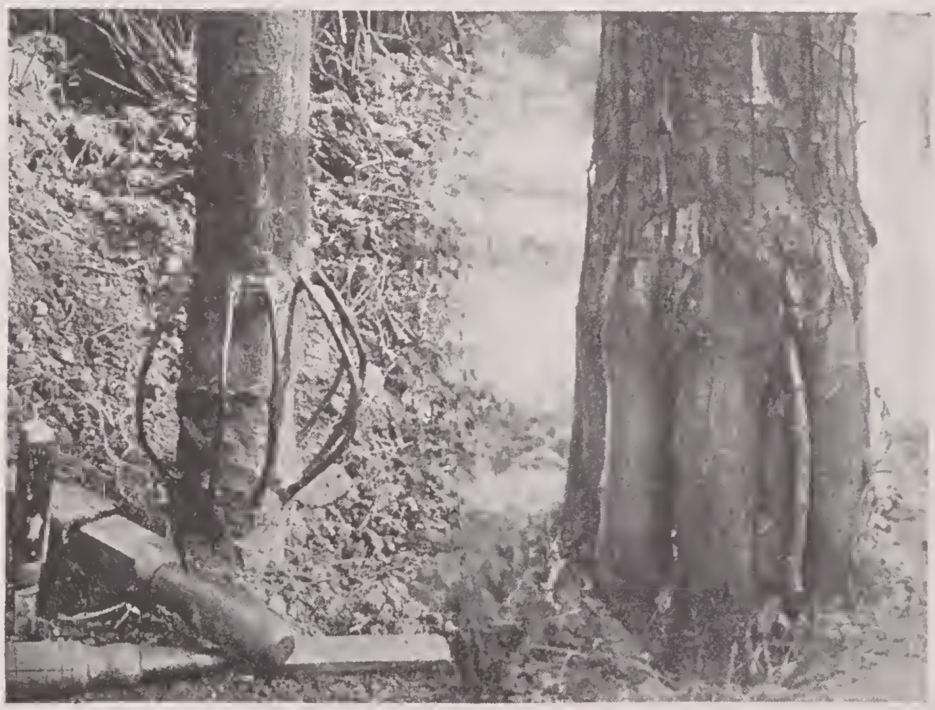
The United States is the leading fruit-growing nation both for quantity and variety of fruits grown, and the crop in some years is worth in the neighborhood of $500,000,000. Apples are the most important fruit crop and the most widely distributed, having been developed in a thousand varieties, some of them well adapted to growth in northern latitudes. California is far in the lead as a fruit state, shipping large quantities of oranges, lemons, peaches, pears, and grapes. New York, Pennsylvania, Ohio, Michigan, Illinois, and Indiana are other important fruit states, and irrigation is bringing new areas in the Southwest into the fruit belt. Washington, Oregon, Colorado, and Idaho furnish delicious apples, cherries, pears, and plums; Florida grows pineapples, oranges, grapefruit, and other tropical fruits; Colorado sends melons, and Georgia contributes peaches before the northern crops are ready.

Of the native fruits there are still to be found wild crab-apples, wild plums, and cherries. Berries, such as raspberries, strawberries, blackberries, and gooseberries, are found both cultivated and growing wild. Blueberries grow wild in a limited area and their cultivation has only been undertaken as an experiment on a small scale. Cranberries, which grow wild in cool climates, are extensively cultivated in some of the northern states. Elderberries and the scarlet haws or thorn-apples are little known, although the wild fruit is used for making jellies. The wild grape, papaw, and may-apple or mandrake are also found in the wildwood.

Starting and Caring for an Orchard

The fruit-grower chooses well-drained land for the orchard site, with good subsoil to a depth reached by the tree roots. The young trees grown in a nursery are set out in regular spaced rows in the orchard when they are one or two years old. The orchard is cultivated to keep out the weeds and sometimes cover crops such as clover or alfalfa are grown and then turned under to add nourishment to the soil.

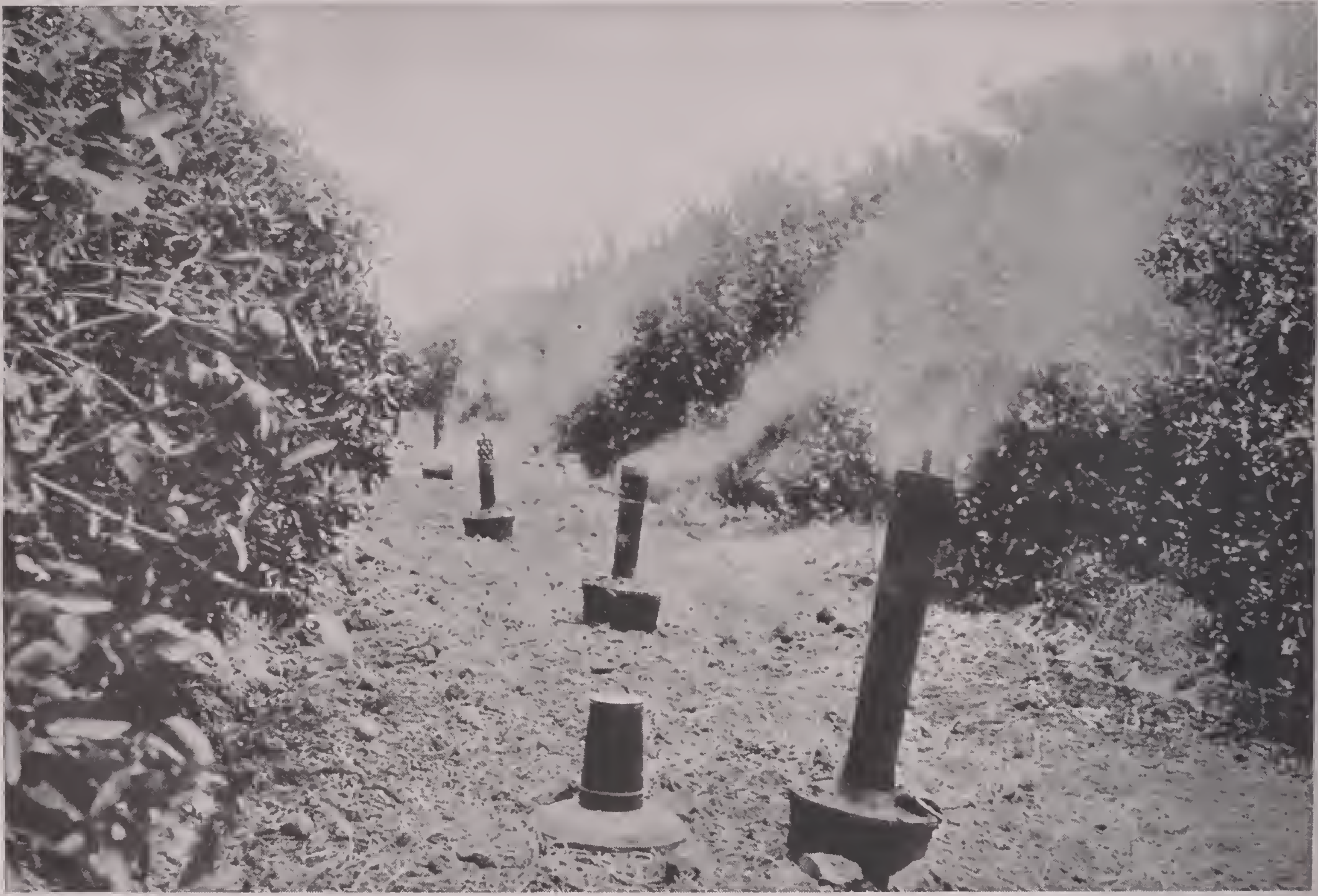
SAVING A TREE'S LIFE



Rabbits and other small gnawing creatures sometimes chew off a circle of bark around the base of a tree. When a tree has been "girdled" in this way, the sap cannot rise and the tree will die unless something is done quickly to save it. Here is one of the rescue methods, called "bridge grafting." The tree on the left is newly grafted. In a few years it will look like the tree on the right, for not only do the grafts carry the life-giving sap, but they grow along with the rest of the tree.

Another important operation in orchard and vine-

SMOKING JACK FROST OUT OF THE ORANGE GROVES



Even in the warm climates where oranges grow, the nights sometimes are cold and Jack Frost is liable to do a good deal of damage if precautions are not taken. Accordingly, little stove-like affairs, such as these, containing oil, coal, coke, or wood, are set through the orchard, and while the heat warms the atmosphere the smoke helps to form a protecting blanket.

yard is that of spraying to prevent injury to the tree or its fruit from insect or fungus pests (*see* Spraying). Pruning is also very necessary to good fruit. By a proper cutting back of wood growth, fruit-bearing wood may be given increased vigor and the tree opened up so the sunshine will reach the fruit. Pruning away dead branches prevents injury to the tree through spread of the decay, removes a natural harbor for insects and other enemies of the trees, and removes weight that would uselessly encumber the tree. Even old neglected orchards may be restored to bearing by proper pruning and care.

Fighting Off the Frost

Frost coming after the trees have begun to bud can do an enormous damage to the orchard (*see* Orange). When warning of an untimely frost is sent out by the weather bureau among the fruit-growers of any region, they act promptly to save their precious trees. Smudge fires are started all through the orchard forming a blanket of smoke overhead to prevent the loss of heat through evaporation during the night. For the same purpose a curtain of vapor may be formed over the orchard by spraying water high into the air, and still another method is to fill with hot water a system of pipes running all up and down the rows of trees to keep the temperature above the freezing point.

Fresh fruits, like green vegetables, contain large quantities of water, and are not substantial foods. Their great value lies in their aid to the digestion of other foods and in the desirable vegetable salts which they contain. Dried, preserved, and canned fruits hold a very important place in our diet (*see* Canning Industry; Dehydrated Food).

Fruits in the botanical sense are the parts of the plant which contain the seeds. To the botanist, the seed-carrying portions of all plants are fruit, even if we do not commonly think of them as such, so that we may name three main fruit classifications: (1) fleshy fruits, such as berries, oranges, melons, gourds, and apples, with seeds in the flesh; (2) stone or drupaceous fruits containing pits or stones, such as plums, peaches, and cherries; (3) dry fruits, including nuts, grains, legumes such as beans and peas, and capsules, pods, or similar containers such as the seed vessels of flowers. In the fleshy fruits, the whole seed envelop or *pericarp* is fleshy or juicy. In the drupes, the part of the fruit around the seed (the *endocarp*) becomes hard or stony, forming the peach or plum or cherry "pit," while the outer portion (the *exocarp*) is fleshy. Dry fruits may be divided into "splitting" fruits, like peas, beans, and poppy capsules, which break open and scatter the seeds, and "non-splitting" fruits, like acorns, grains, and nuts.

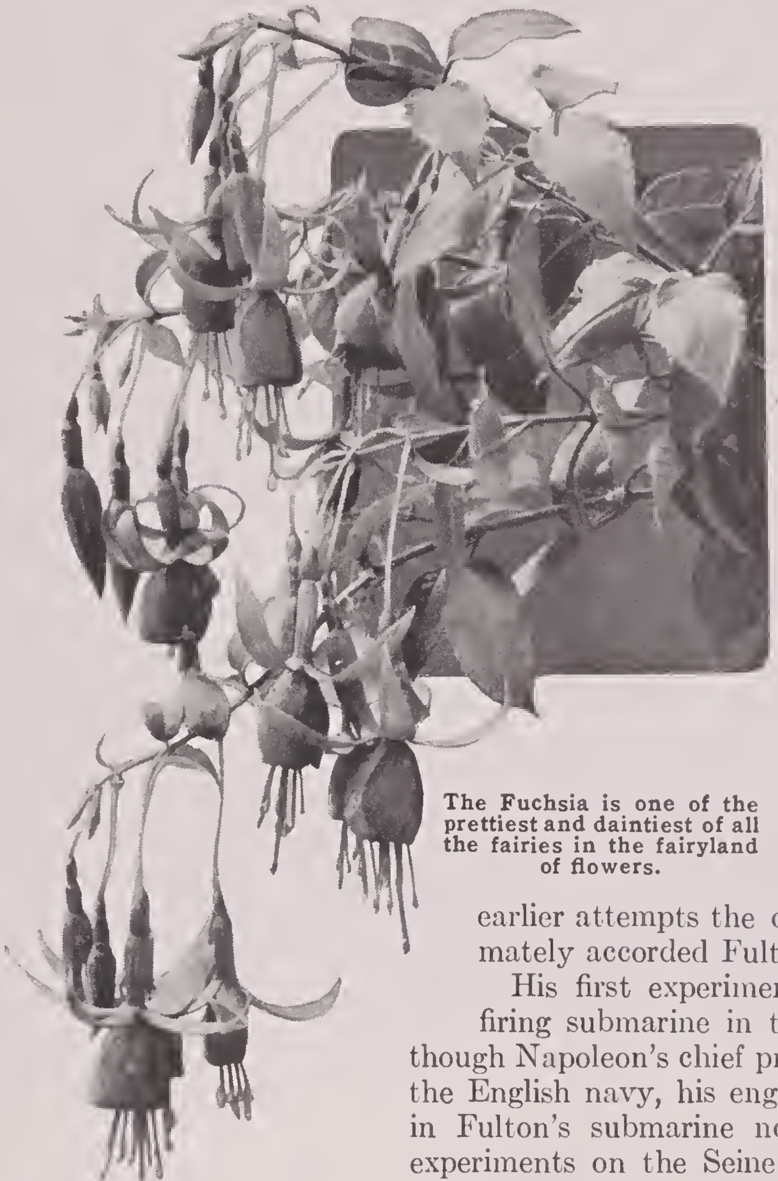
FUCHSIA. "What a beautiful plant!" exclaimed a London nurseryman as he entered a sailor's dwelling in the dock district. "Where did you get it?"

The sailor's wife smiled as she looked at the flower that had come from far-off Chile. "My husband brought it from foreign parts," she answered proudly.

The nurseryman recognizing it as one of the same rare plants that had been brought from South America that very year (1788) and placed in Kew Gardens, promptly bought it and procured from its cuttings several hundred plants which he sold for a high price. From these specimens and from others brought chiefly from Central America, Peru, and Chile have come the many plants whose brilliant drooping funnel-shaped blossoms of purple and rose and white make so gay a showing in our old-fashioned gardens and in our homes.

Careful cultivation, selection, and cross-pollination produce an almost unlimited number of interesting varieties. The nectar of the flowers contains an unusually large percentage of cane sugar, and the little four-celled berries are sometimes sweet and good to eat. From certain species a dye is obtained.

The fuchsias are a genus of plants of the evening primrose family (the *Onagraceae*) containing about 70 known species, mostly natives of tropical America. The common fuchsia or "ladies' eardrop" (*Fuchsia macrostemma*) has 4 light petals borne in the throat of a colored funnel-shaped calyx, 8 stamens projecting outside the corolla, and a 4-celled berry.



The Fuchsia is one of the prettiest and daintiest of all the fairies in the fairyland of flowers.

FULTON, ROBERT (1765–1815). When the first wholly successful steamboat, the *Clermont*, was launched on the Hudson River in 1807, Robert Fulton's old friends in Lancaster, Pa., probably were not surprised. They had always expected the quick-witted, ingenious Irish boy, who had grown up among them and had already won a name abroad by other inventions, to succeed.

This inventor of the steamboat was born on Nov. 14, 1765, on a farm in what is now Fulton Township, but the family soon afterwards moved to town and, the father dying, was left to a rather precarious manner of living. At 17 Fulton went to Philadelphia to work for a jeweler and study art. So well did he use his time and talents that at 21 he had $400 to invest in a farm for his mother and sisters before going to London to study art with Benjamin West.

But a lively-minded youth who earned $400 and bought a farm while studying painting evidently had practical qualities. English friends encouraged Fulton to turn engineer, and art was soon forgotten in the midst of a series of useful inventions of dredging-machines, flax-spinning and rope-making devices, and a substitute for canal locks.

When many minds were thinking how steam-engines could be used to shorten distances on land and sea, it was not surprising that the American from the land of rivers, canals, and great distances turned his mind to the steamboat. He knew of the numerous experiments, some of them quite promising, that had been made by English and American inventors for a century before. A little more persistence or a little more support might have given any one of several earlier attempts the distinction which was ultimately accorded Fulton's experiment.

His first experiments were with a torpedo-firing submarine in the harbor of Brest. But though Napoleon's chief problem was how to combat the English navy, his engineers were not interested in Fulton's submarine nor in his first steamboat experiments on the Seine. Robert Livingston, the American minister, was. He had already been promoter of a company to run steamboats on the Hudson. Fulton returned to America as a partner of Livingston to work out a practical steamboat.

Robert Fulton succeeded where others failed, for he was shrewd, practical, determined, with a charm that won him friends and the necessary money for his plan. The scoffers might call his boat "Fulton's folly" or a burning sawmill on a scow. He knew it would work and it did. On Aug. 17, 1807, the *Clermont* with her English-built engine made her trial trip from New York to Albany—150 miles upstream—in about 30 hours. The craft created tremendous excitement and won immediate favor. In 1815 Fulton built for the United States the first steam warship. He was never wealthy and lawsuits about patents and overwork undermined his health. He died in New York City Feb. 24, 1815.

FUNGI (*fŭn'jī*). A large group of very simple plants, distinguished by the fact that they do not contain the green coloring matter (chlorophyll) possessed by higher plants, are known as *fungi*. This group includes all molds, mildews, rusts, smuts, bacteria, truffles, puffballs, toadstools, and mushrooms. Being without the chlorophyll, with which to manufacture their food out of raw materials, the fungi are compelled to live upon the food produced by other plants and animals. When they get their food from living creatures, fungi are called "parasites"; when they live on dead animal or vegetable matter, they are called "saprophytes." Parasitic fungi do a vast amount of harm in the world, causing diseases in men, animals, and plants. The saprophytes, on the other hand, do a great deal of good as scavengers.

THE "GHOST FLOWER" AND THE "DEATH CUP"

The plant on the right is the deadly Amanita or "Death Cup," one of the most poisonous members of fungus society. On the left is that strange plant called Indian Pipe or "Ghost Flower," which is often found growing in moist dark northern forests. While it is not classed as a true fungus, it looks and behaves very much like one, for it has no green coloring matter and gets its nourishment from the roots of other plants and from decaying vegetable mold.

Fungi range in size from the tiniest molds to the huge toadstools. Many varieties such as the lichens are eaten by wild animals. Some, like mushrooms and truffles, are highly prized delicacies for human food. Certain others are used for making drugs and dyes. Yeasts are among the most useful of all fungi.

Fungi are divided into four groups: *Bacteria; Phycomycetes*, such as black mold, downy mildews; *Ascomycetes*, such as mildews, truffles, cup-fungi, yeasts; *Basidiomycetes*, or rusts, smuts, mushrooms, toadstools, and puffballs.

FURIES. These avenging deities of Greek and Roman mythology were daughters of Night, or according to another myth they sprang from the blood of the mutilated Uranus when he was slain by his son Saturn or Cronos. The Greeks called them *Erinyes*, the "angry ones." They also called them *Eumenides*, the "well-minded" goddesses, probably because they feared to call such terrible beings by their true name.

Their number varied, but usually they were spoken of as three: Megaera (the grimly jealous), Alecto (the unwearied persecutor), and Tisiphone (the avenger of murder). Nothing, it is said, escaped their sharp eyes, as they pursued the evil-doer with speed and fury, permitting him no rest. A famous drama of the Greek poet Aeschylus deals with their pursuit of Orestes, son of Agamemnon, for the slaughter of his guilty mother Clytemnestra.

FURNACE. The type of furnace with which you are probably most familiar is that which heats the air or water or generates the steam by which houses and public buildings are warmed (*see* Heating and Ventilation). But there are also various types of furnace used in manufactures. These may be classified as furnaces in which the fire and the material to be heated are brought into contact—as in the blacksmith's forge, the blast furnace, and the cupola; furnaces in which the fuel is in one compartment and the substance to be heated in another—as in the reverberatory furnace used in making iron and steel; and furnaces in which the material to be heated is in a closed chamber or sealed retort heated by external flames, hot gases, or electricity—as in pot furnaces for making glass and crucible furnaces for making steel (*see* Glass; Iron and Steel).

Perhaps the most interesting type is the modern electric furnace, out of whose furious blasting heat have come some of the most amazing achievements of modern chemistry. With the aid of its tremendous temperatures—7,000° Fahrenheit and more, double that of the hottest furnace fed with ordinary fuel—we can melt platinum, chromium, tungsten, molybdenum, and other refractory metals from their ores. We can fuse quartz and blow it like glass to make flasks, retorts, and "pyrex" kitchen ware, which may be heated red hot and plunged into ice water without breaking. We can take carbon in one form, ordinary coal, and turn it into another form, graphite. Carbon and silicon are fused into one of the hardest substances known, carborundum, so much used for grinding and polishing metal. Carbon and lime are forced to unite to make calcium carbide, which we use to make acetylene gas. Phosphorus is stewed out of phosphate rocks, to be used in making matches. Most of the alloy steels, so indispensable to the automobile manufacturer and the maker of high-speed tools, are made in the electric furnace; and the electric furnace is being used more and more instead of the Bessemer and other processes in the production of iron and steel.

Most wonderful, perhaps, of all the miracles of the electric furnace is the fixation of atmospheric nitrogen. Enormous furnaces in which electric arcs are drawn out into great disks or spirals of flame are used to force the nitrogen and oxygen of the air to combine, forming nitric oxide, which is easily turned into nitric acid or nitrates for fertilizers and explosives.

There are several types of electric furnace, but they all consist essentially of a crucible of some non-conducting heat-resisting material, such as limestone, inclosing two carbon electrodes. When the current is turned on, an electric arc is formed between the electrodes. If the current, instead of passing through the air, is passed through a liquid, the furnace is of the electrolytic type; if through a solid, it is of the incandescent type.

FURNITURE *Making*—ANCIENT *and* MODERN

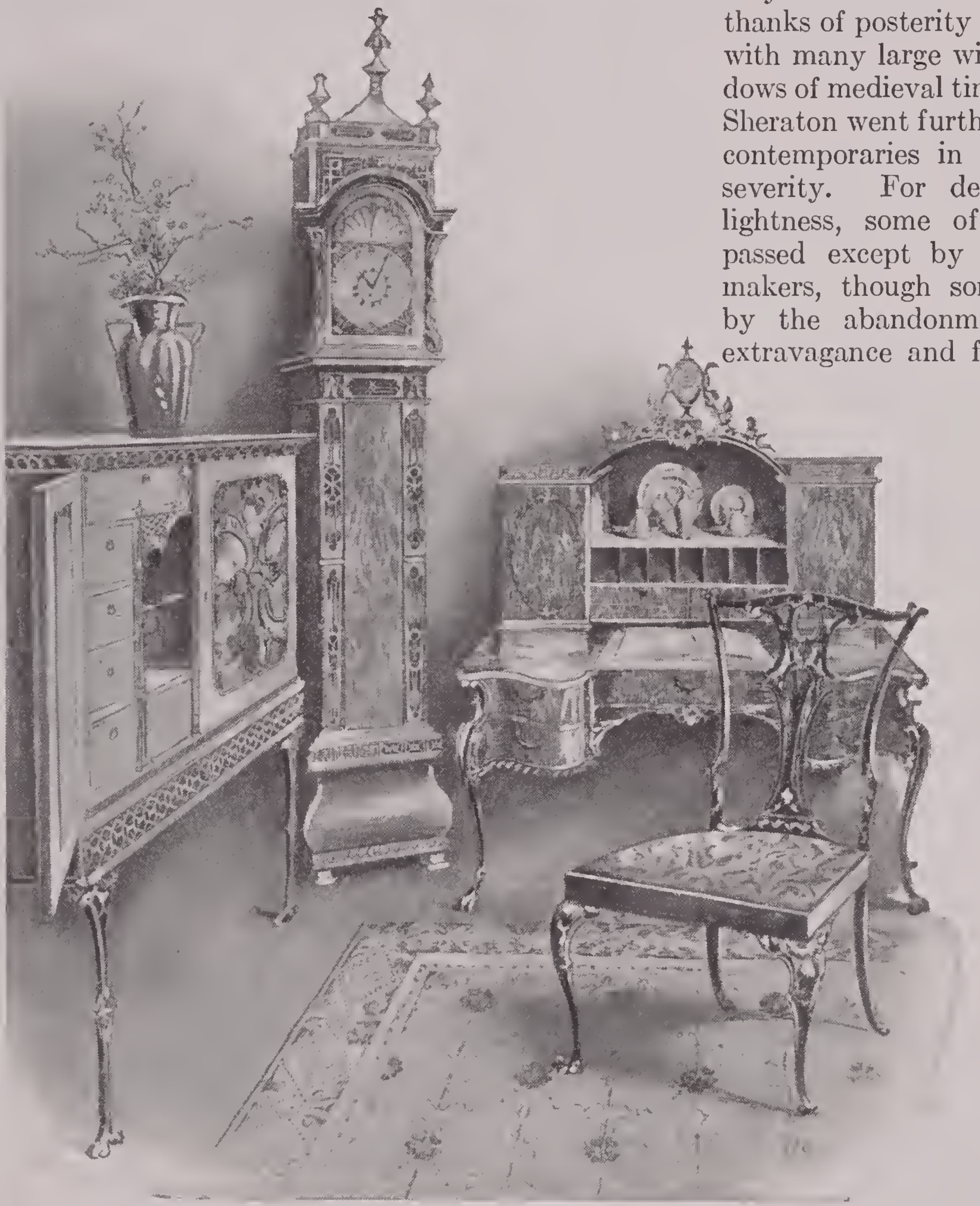
One of the greatest of furniture makers—Thomas Chippendale—is shown here working with an apprentice on one of the beautiful tables which made his name famous. This careful hand labor of the master craftsman has today been replaced by the speedier but less artistic work of whirring machines, as illustrated at the end of this article.

FURNITURE. The making of furniture distinguished for beauty and grace, as well as merely for utility, was once a handicraft which great artists did not feel to be beneath their dignity. Today, the invention of modern machinery has made it a factory process, in which fine individual workmanship is too often lacking. Accomplished artists are employed by manufacturers, it is true, to design furniture, but the substitution of the machine for the workman has robbed even the finest specimens of modern furniture of a great part of the artistic charm and personal touch which delight the collector of specimens made in earlier times. On the other hand, furniture-making is one of the most widely dispersed industries in the United States, with a combined annual output valued at about $300,000,000.

In ancient times and throughout the Middle Ages, houses were very scantily furnished. Chairs were reserved for the lord of the house and favored guests; stools and benches, chests for clothing, beds, and tables—which were often just boards laid across trestles—formed the greater part of the furniture. Egypt, Greece, Rome, and other ancient nations had elaborate pieces of furniture made of ivory, bronze, silver, and gold, and decorated with precious stones, but these were rare and belonged only to the great. The poorer classes had no furniture save of the meanest sort. The early Egyptians were adept in woodworking, and pictures on their tombs and some pieces that have been preserved indicate that they had wooden furniture, sometimes carved and gilded and covered with splendid textiles. The oldest known piece of furniture in the world, now in the British Museum, is a wooden throne of an Egyptian queen who lived 3,000 or more years ago. It shows considerable artistry and skilled handiwork.

The period of the Renaissance marks the first important development in furniture-making. Florence, Milan, Rome, and Venice became important centers of cabinet-making, and making the home a place of comfort and beauty was for the first time given serious consideration. In France, especially in the age of Louis XVI, in the last quarter of the 18th century, furniture of exquisite design was produced, decorated with carving, painting, inlaid work, and bronze and brass ornamentation. In England also the latter part of the 18th century—the mid-Georgian period—was the great period of achievement in furniture-making. Mahogany and satinwood took the place of oak, and grace and beauty of design, accompanied by skilled craftsmanship, marked the work of Thomas Chippendale, George Hepplewhite, Thomas Sheraton, and the Adam brothers, the masters whose work still stands as a model for furniture makers.

EXAMPLES OF CHIPPENDALE FURNITURE



Many think that Chippendale did his best and most characteristic work in the designing of chairs. But his designs of cabinets, cases for tall clocks, and writing desks, such as those you see in this illustration, are equally distinctive. His work was distinguished for delicacy and lightness of structure and exquisite carving.

Chippendale, the first and greatest of this group of artists, found English furniture for the most part merely a tasteless jumble of the various Continental and earlier English styles. He devoted his life to preaching the gospel of beauty in furniture, and producing chairs, tables, and other articles that were strong as well as handsome, useful as well as ornamental. Chippendale's work, reinforced by his famous book on furniture-making, revolutionized the whole trade in England. About the same time Robert Adam and his three brothers were doing an almost equally important work, in making the house and its decorations and furnishings an artistic whole. Though they were architects by profession, these men designed furniture of all types to fit the beautiful houses they created. The Adam brothers also deserve the thanks of posterity for being the first to build houses with many large windows, instead of the small windows of medieval times that still survived in England. Sheraton went further than any of his predecessors or contemporaries in the direction of simplicity and severity. For delicacy, harmony, balance, and lightness, some of Sheraton's designs are unsurpassed except by the best work of the French makers, though some of his later work is marred by the abandonment of his own principles for extravagance and fantastical forms. The foundations laid by this brilliant mid-Georgian school, and by the French artists, have been used ever since for the finest creations of the best furniture makers.

About the same time the simple and substantial colonial furniture began to be designed in America, establishing a vogue that extends to this day. Most of the early cabinet makers of America lacked any artistic training, and their furniture was heavy and unattractive. In 1815 the steam lathe was first applied to the making of furniture, and in 1825 the circular saw was invented. Furniture which formerly had been very plain was now covered with elaborate meaningless scroll-work and moldings, easily produced by the new machinery. Since 1859 most furniture has been made by machines, which cut, polish, and even assemble the articles. Some of the polishing of furniture is still done by hand, but there is very little individual construction work.

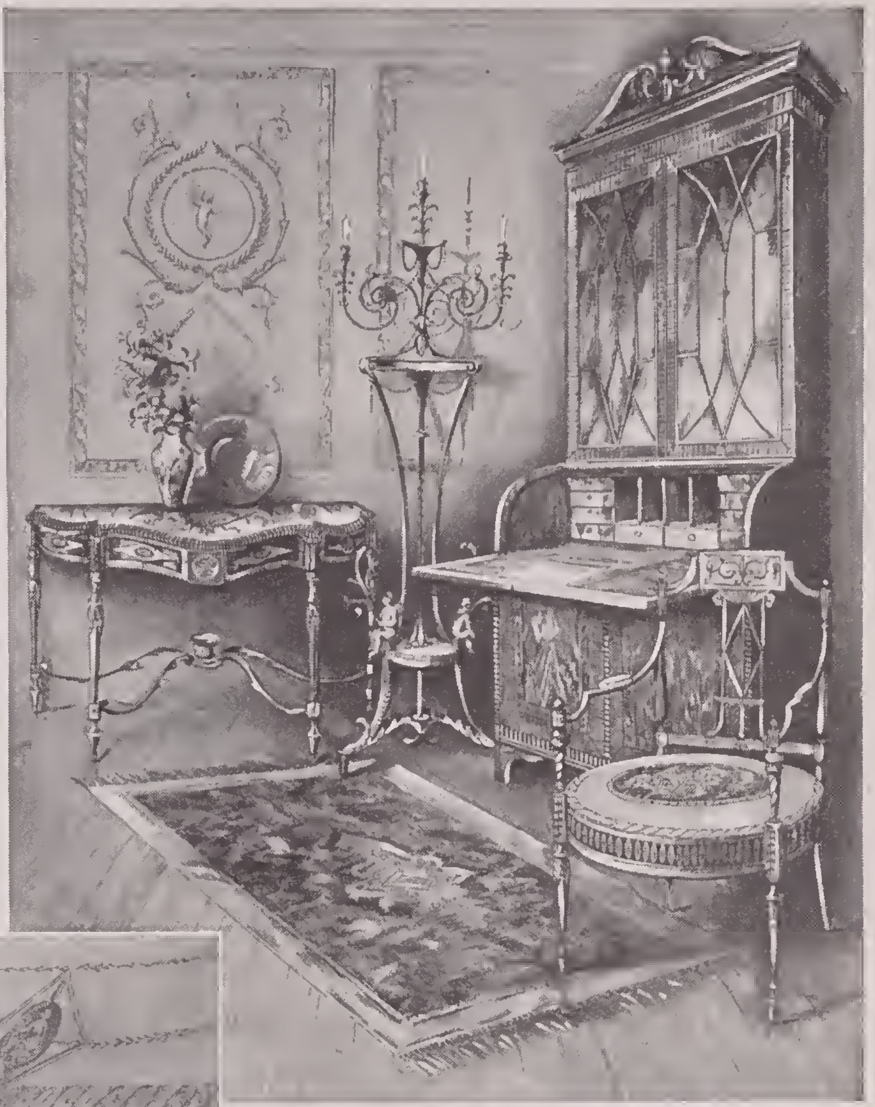
In the last generation, largely inspired by the work of the English artist, William Morris, there has been a growing demand for a revival of the old designs of simple and beautiful construction. The best work of the old masters has been copied and adapted, so that it is now possible to obtain furniture of beautiful design and finish at a moderate price.

The manufacturers of America are responsible for many unusual contrivances in furniture, including rocking chairs, combination chiffoniers, and folding beds and couches. The extension of the teaching of woodwork in schools is likely further to elevate the standard of taste and workmanship in furniture manufacture. In recent years chairs and other articles of furniture made of wickerwork and other forms of basketry have found much favor. These are woven by hand from "osiers" or willow shoots and various tall woody grasses known as "reeds." The so-called "fiber" furniture, which is woven from paper compressed into strands or twisted over wires, is said to have the merit of being more durable than either willow or reed.

The woods used in making furniture are varied, and change as often as do the designs. Early in the 19th century black walnut, maple, and mahogany were fashionable; then cherry and ash came into vogue. Oak was long forgotten, but toward the close of the century it took a prominent place, and is still popular for the hall, library, and dining room; while black walnut, once so fashionable, has passed almost entirely out of use. For bedrooms mahogany, curly birch, and maple are now much used, and for the dining and drawing rooms mahogany is still first choice in the better grades of furniture. Frequent changes have taken place also in furniture upholstery, an almost endless variety of textures, patterns, and qualities in coverings having superseded the slippery haircloth and other materials which were so popular a few decades ago.

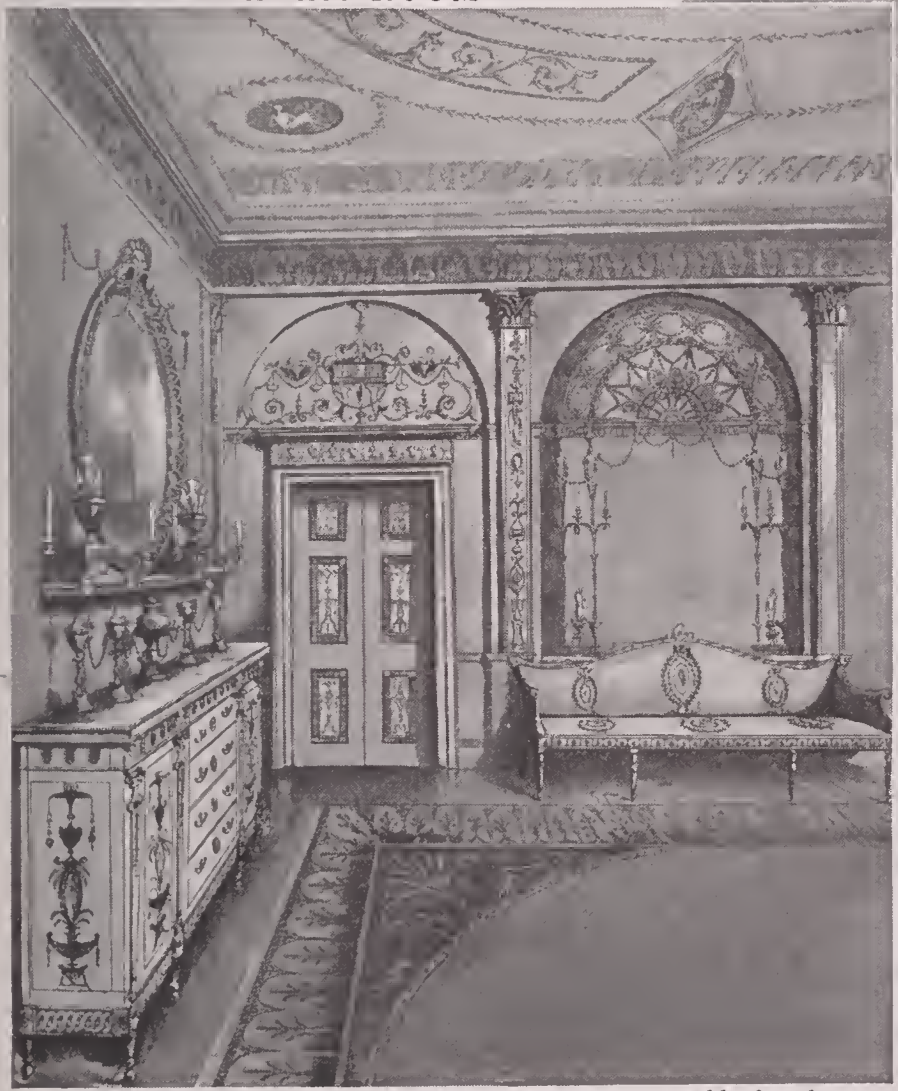
The great centers of the furniture-making industry in the United States are New York, Chicago, Grand Rapids (Mich.), Philadelphia, St. Louis, and Boston.

A CORNER IN A SHERATON ROOM



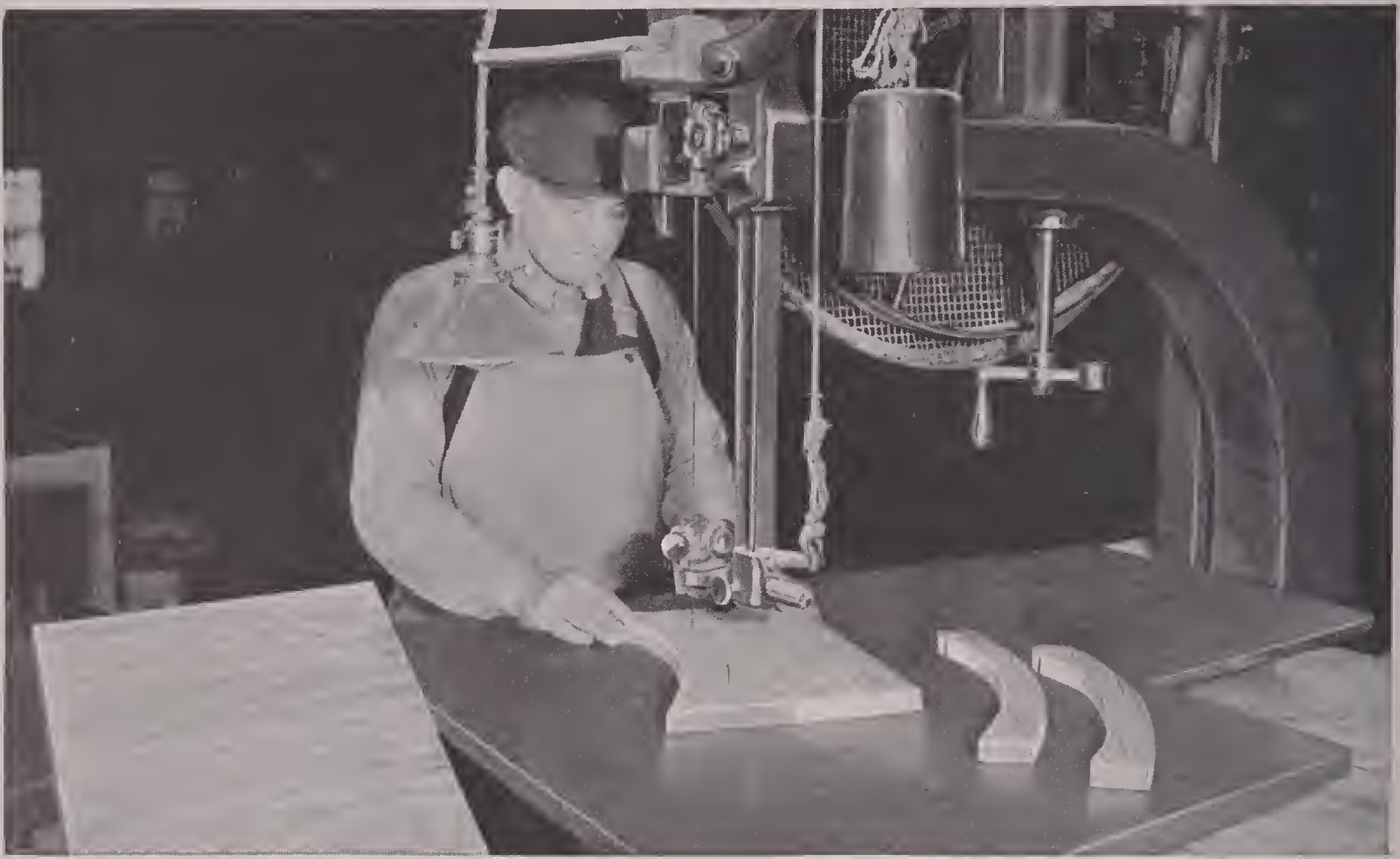
The chairs made by Sheraton, like those of Chippendale, are known for their grace and delicacy, although you see a Sheraton chair is very different from a Chippendale chair. His furniture was distinguished by slender forms and sweeping curves, and he made extensive use of inlaid woods, as shown in the charming little table against the wall.

AN ADAM ROOM

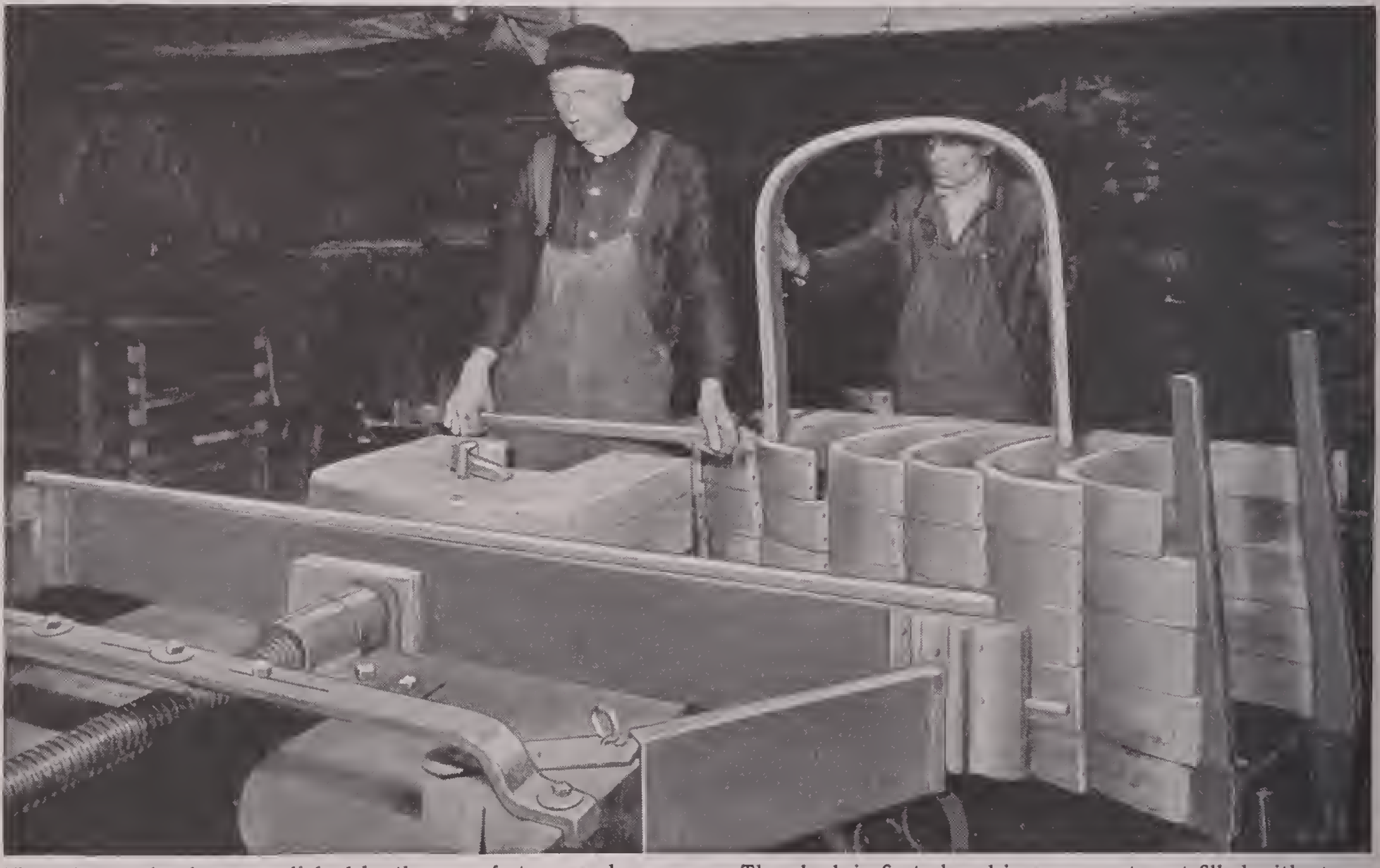


The Adam brothers of 18th century Scotland were notable for the care and skill with which they made their furniture harmonize with the design and decorations of the houses which they planned.

MAKING THE CURVED PARTS OF FURNITURE

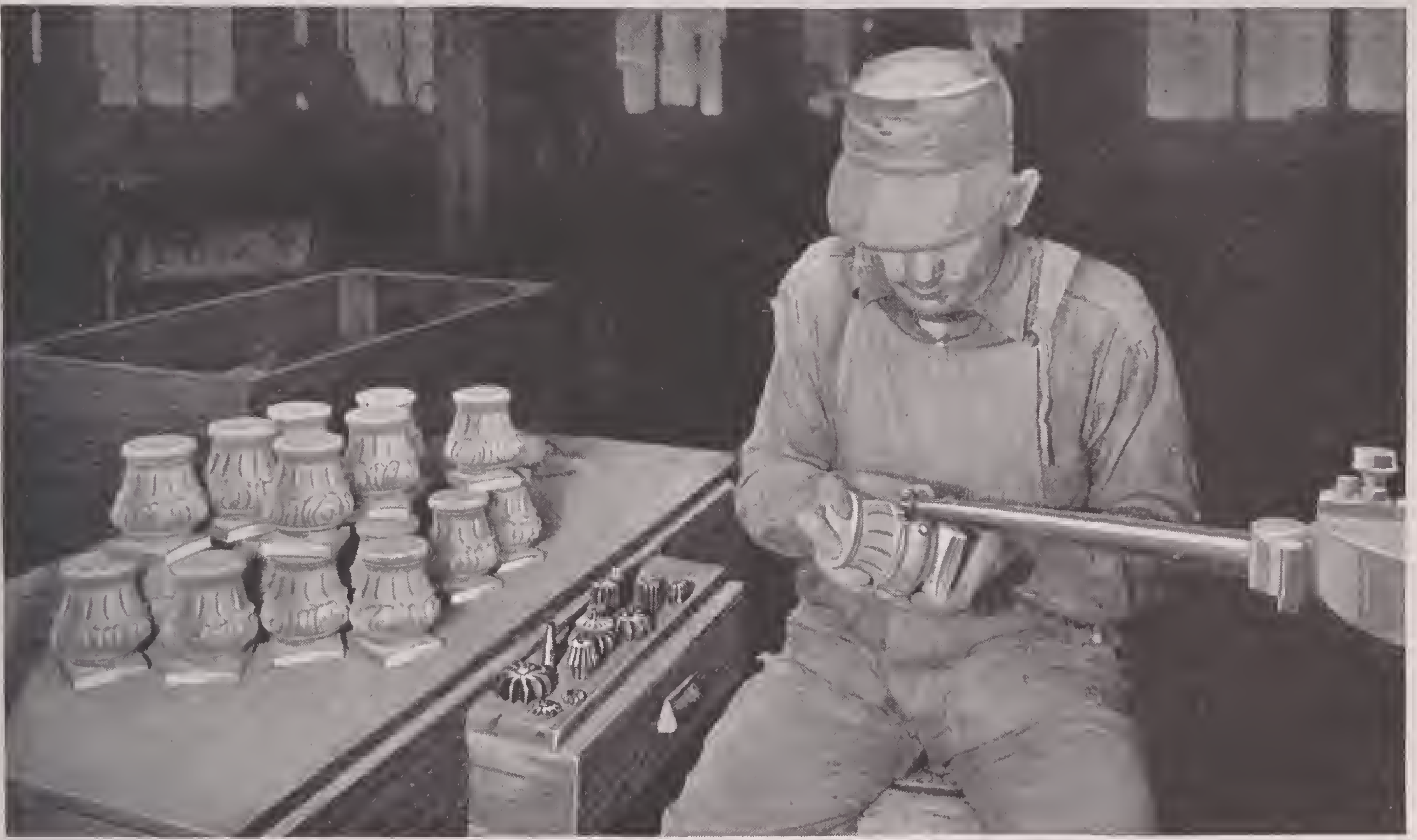


The illustration shows one of the methods of making curved parts for furniture. The pattern which has been marked on the wood is cut out with a band saw, operating at great speed through a hole in the steel table.

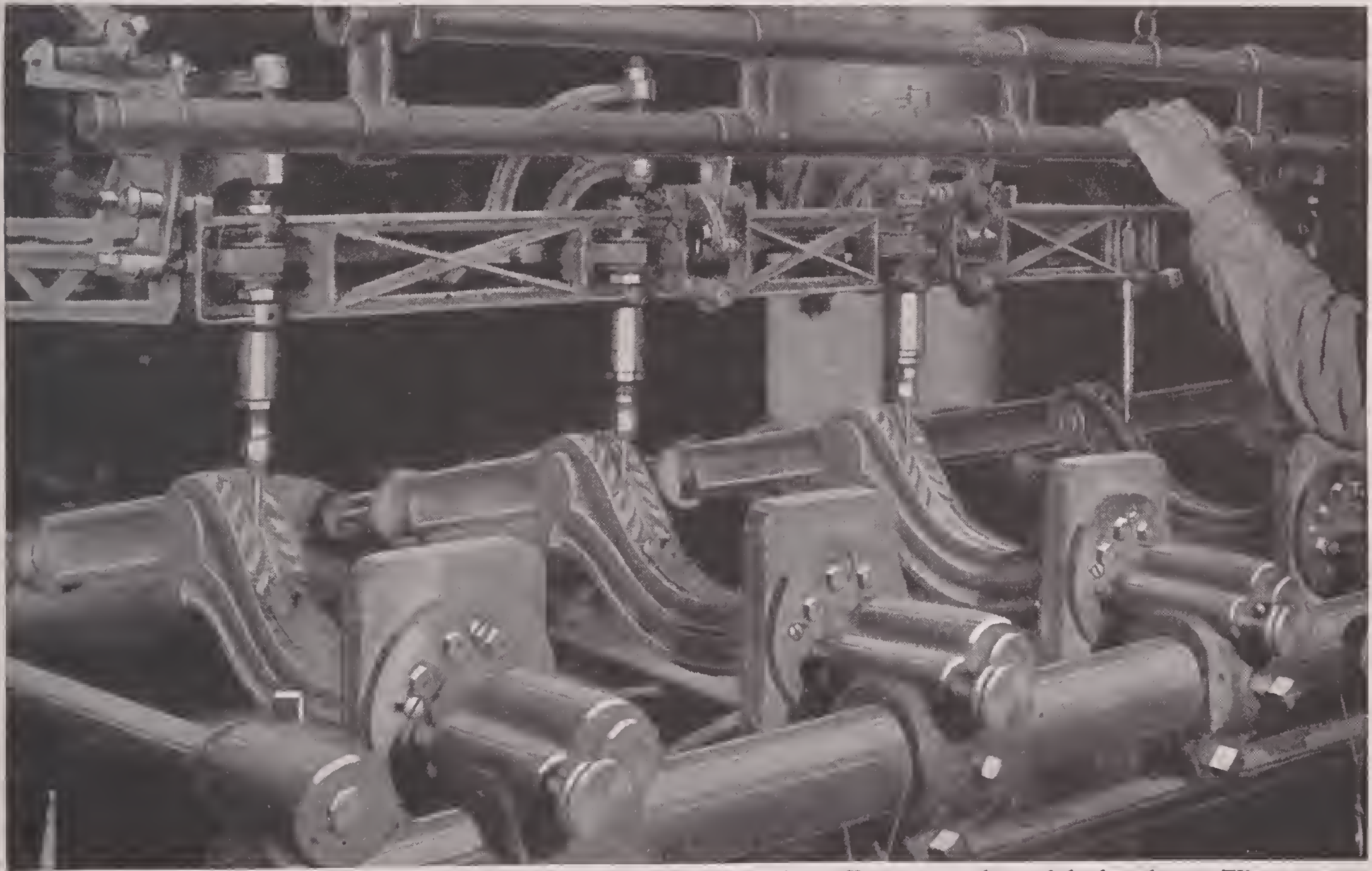


Here the curving is accomplished by the use of steam and pressure. The plank is first placed in a compartment filled with steam to give it pliability so that it will not break when put into the press. After being steamed, the plank is fastened in the pliable metal holder which you see here. The machinery then pushes both ends forward around that curved form, until the wood is bent to that shape. Then the man fastens both ends with the clamp he holds in his hands, and after it has remained for a time in this position, it holds its curved shape.

HOW WOOD CARVING IS DONE BY MACHINERY

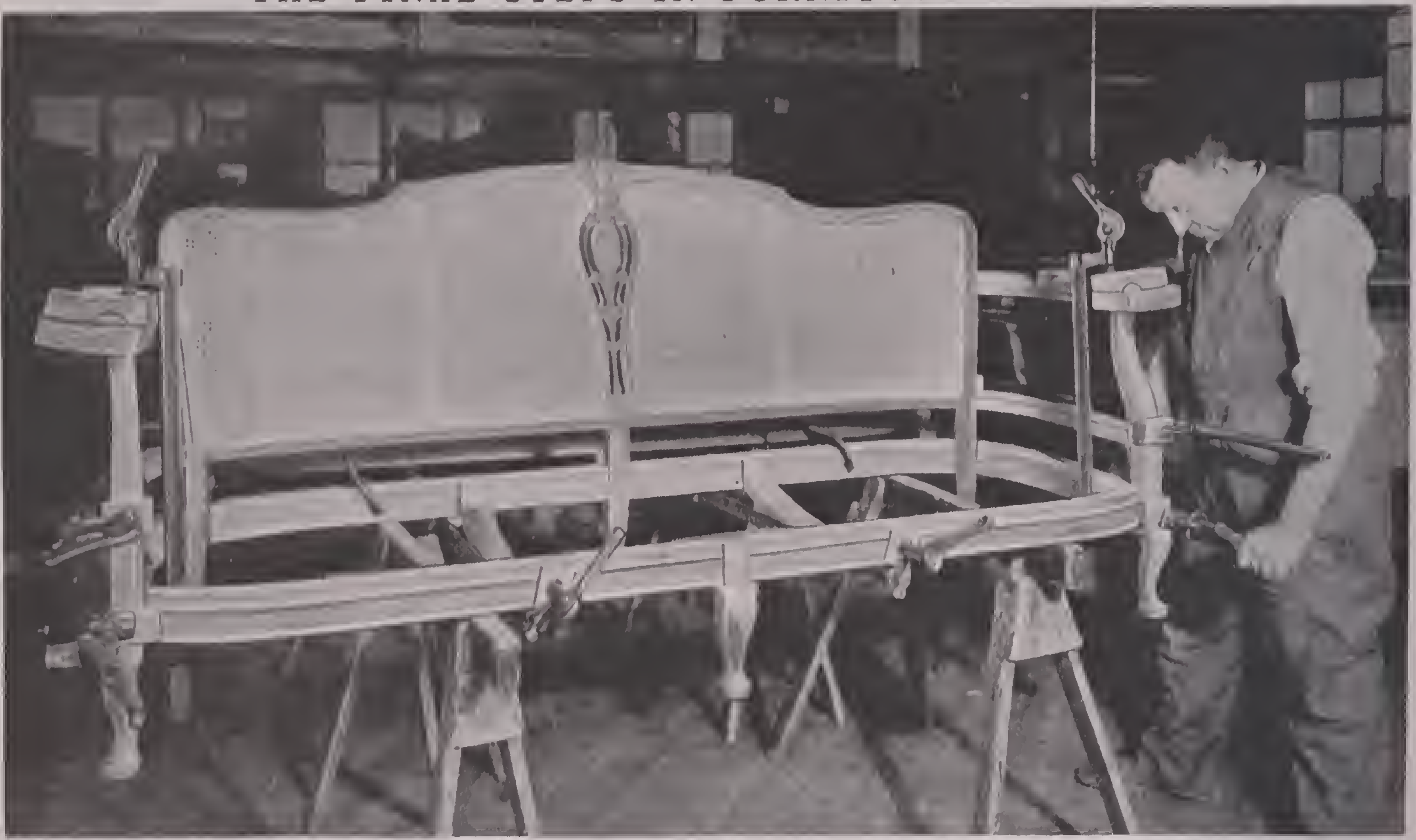


The man in the upper picture is a "spindle carver" and is making some ornamental pieces for legs and other parts of furniture. He takes a perfectly smooth piece of wood of the form required and by the use of those little rotary knives of various shapes, cuts it in intricate designs. The appropriate knife is attached, as you see, to the revolving arm and the workman has only to hold the wood at the proper angle.

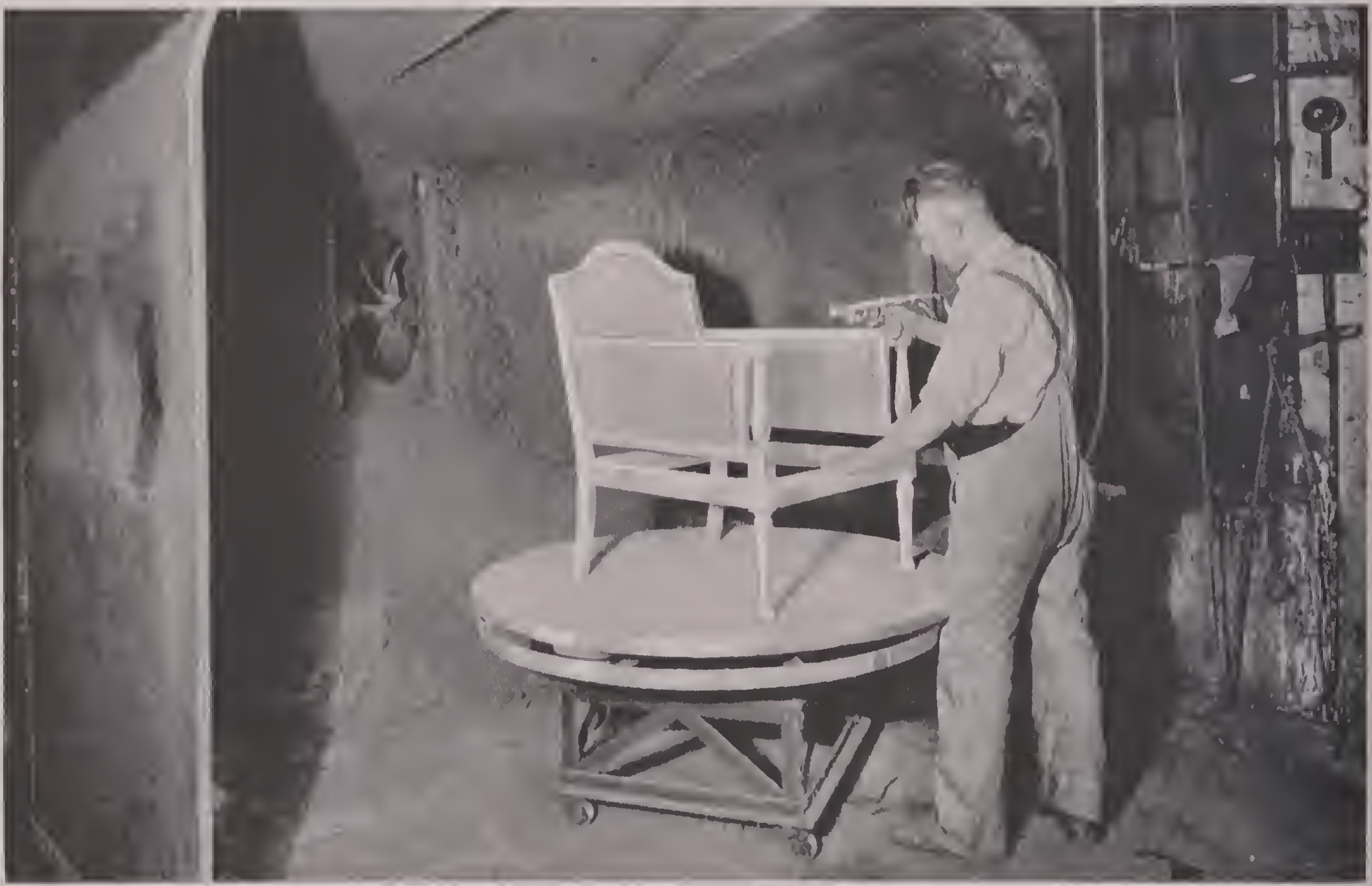


This picture shows a machine that carves six legs exactly alike at the same time. You can see three of the legs here. What appears to be a fourth leg, at the right, is a steel pattern. The machine works on the principle of the pantograph. On the right, directly under the man's hand, is the guiding needle which goes over the pattern. The revolving knives repeat this pattern exactly on the wooden legs. Every furniture factory has many machines of this type.

THE FINAL STEPS IN FURNITURE MAKING



Once the parts of a piece of furniture have been cut out, shaped, and carved, they are brought together in the assembling room, where they are fitted together. If they match properly, they are fastened in place with pegs and screws and glue. Then heavy clamps are screwed on, as you see in the case of this sofa. These clamps hold the parts in position until the glue has "set," which usually takes from one to three days.



When the glue is dry, the furniture is taken to the paint shop. But no tedious work with the paint brush goes on there. The colors are sprayed on with a hose and nozzle, covering a chair like this one in a minute or so. The cage the man is working in is to prevent paint from scattering, while the fan drives out dust which might settle on the wet paint.

FURS. What visions the word "furs" calls up—of remote lands and waters, of savage warriors and lonely trappers, of Arctic travel and hardships, of lovely ladies and wealth beyond calculation! The skins of fur-bearing animals are bound up with the history of nearly all civilized peoples. Wherever winters were cold, one of the first concerns of primitive man was to provide himself with garments made from the warm thick coats of animals, for garments of skins and furs were worn long before he had learned to prepare wool. For furs he hunted and toiled, and when he had obtained more than he needed himself, he traded them to his fellows for food and weapons. Thus furs became an early medium of barter and exchange; and as the people of more temperate regions came to covet them for ornament as well as warmth, the fur-trade became one of the chief of primitive industries and remains of great importance to this day.

To get the rarer and more beautiful skins, men have dared the dangers of the jungles of the tropics and the trackless wastes of Arctic snows. Tribes have fought with tribes and nations with nations for the sake of furs. In their insatiable demands for furs men have mercilessly hunted some of the most prized species, until such animals as the beaver, the fur-seal, and the sea-otter were threatened with extinction. In all ages the more costly furs have been the badge of wealth and dignity. In the Middle Ages the snowy white ermine with its black-tipped tails could be worn in England by none but members of the royal family, and ermine today is used in nearly all state robes of judges and members of the English court. Cat and rabbit fur in medieval times were the badge of the humble townsmen.

The colonization of North America is inseparably linked with the fur-trade, the Hudson's Bay Company being the chief agency. The fur-trader led the way across the Alleghenies in the American colonies and up the St. Lawrence in Canada. The first settlements were mere trading posts, to which the Indians brought the furs they had trapped and bartered them for guns and other articles. To name such outposts of the fur-trade as Vincennes, Detroit, Green Bay, Fort Snelling, Kaskaskia, Cahokia, Astoria, is to recall the early history of the great West. Other pioneers followed in the trail of the fur-trader, settled at or near the trading posts, and thus formed the nucleus of many of the great cities and thriving towns of today.

A HUNTER'S AND FUR TRAPPER'S CABIN IN NORTHERN CANADA

This scene is typical of the camps in the distant wilderness, where dwell the men who capture the world's supply of furs. Preparations are under way for the winter campaign, during which the camp will probably be cut off by snow from all communication with civilization. A bear skin is drying on the rack at the right.

The United States is now the chief fur-consuming country, and the increasing demand for furs has caused prices to rise fourfold and more in the last generation. One of the results of this has been the rise of the industry of fur-farming, an outcome of the decrease of wild fur-bearing animals. The most notable example of this new industry is the breeding of the silver fox in Canada, and some of the northern states of the Union. When the value of this new enterprise was realized, a furor of speculation inflated prices until a pair of silver foxes for breeding brought as much as $14,000. Other varieties of foxes, minks, raccoons, and skunks are now bred on farms that imitate as nearly as possible the natural homes of these animals.

Another result of the increasing demand has been the dyeing and counterfeiting of inferior skins to resemble the better varieties. The furs of the domestic cat and wild rabbit masquerade under a wide variety of names. White rabbit fur is prepared to imitate ermine and chinchilla. Clipped and dyed muskrat pelts are sold as "Hudson Bay seal," sable, and otter.

The otters furnish the most durable of all furs. Beaver, seal, raccoon, skunk, Persian lamb or astrakhan, and fox follow in order. The rabbit is the poorest of all, being reckoned as only one-twentieth as durable as otter. (*See also* separate articles under the names of the chief fur-bearing animals.)

PRINCIPAL FURS OF THE WORLD

NAME	SOURCE	USES
Astrakhan	New-born lambs from Astrakhan (Russia)	Muffs, collars, linings.
Badger	N. America, Europe, Asia	Carriage rugs, brushes.
Bear black	N. America	Muffs, capes, rugs.
Bear, brown	N. America, Asia, Europe	Muffs, boas or stoles, rugs.
Bear, grizzly	N. America, Russia, Siberia	Rugs.
Bear, white	Polar regions	Rugs.
Beaver	Throughout North Temperate Zone	Coats, muffs, trimmings, etc.
Cat, domestic	N. America, Russia, Holland, Asia	Linings and imitations.
Civet-cat	S. W. United States, Mexico	Linings, coats, trimmings.
Chinchilla	Peru, Bolivia, Chile	Coats, stoles, muffs, trimmings.
Ermine	Weasels in their white winter coat from N. America, Siberia	Stoles, muffs, linings, state and legal robes.
Fisher (see Pekan)		
Fitch	Polecat of Great Britain	Collars, muffs, trimmings.
Fox, blue (variety of white)	Polar regions	Stoles, muffs, trimmings.
Fox, cross, gray, red	N. America	Coats, stoles, muffs, trimmings, rugs.
Fox, Japan	China, Japan, Korea	Coats, stoles, muffs, rugs.
Fox, kit	N. America, Asia	
Fox, silver	N. America, Siberia	Coats, stoles, muffs, trimmings.
Goat	China, Russia	Coats, rugs.
Hamster	Germany, Austria, Russia	Linings.
Hare, polar	N. America, Siberia	Muffs, stoles, hats, imitations of lynx, fox, sable.
Karakul (Astrakhan of the best quality)	Lambs from Bokhara, Asia	Muffs, collars, linings, coats.
Kolinsky	Polecats or mink from Siberia, China, Japan	Muffs, linings, stoles, imitations of sable.
Lamb, Persian	Persia	Coats, collars, muffs, stoles, trimmings, gloves.
Leopard	China, Bengal, Persia, Africa	Coats, rugs.
Lynx	N. America, Europe, Asia	Trimmings, stoles, muffs, rugs.
Marmot	N. America, Asia	Imitations of mink and sable.
Marten	Europe, N. Asia	Muffs, collars, trimmings.
Marten, Hudson Bay	N. America	Imitations of sable.
Mink	N. America, Russia, China, Japan	Linings, stoles, muffs, coats, trimmings, caps, imitations of sable.
Mole	Europe, Asia	Coats, trimmings, stoles, muffs.
Muskrat	N. America	Linings, coats, robes, hats, imitations of seal, sable, otter.
Nutria	Northern S. America	Caps, hats, gloves, coats, trimmings, linings, imitations of seal.
Opossum, American	Southern United States	Trimmings, stoles, muffs.
Opossum, Australian	Australia	Rugs, robes, stoles, muffs.
Otter	N. America, Asia, Europe	Collars, cuffs, facings of men's coats.
Pekan or Fisher	N. America	Muffs, capes, trimmings.
Pony	Russia, Turkestan	Coats.
Rabbit (European coney)	N. Europe, Australia	Imitations of chinchilla, seal, skunk, etc.
Raccoon	N. America	Men's coats, stoles, muffs, robes.
Sable (a species of marten)	Siberia, China, Japan	Coats, linings, muffs, stoles, trimmings.
Seal	Bering Sea	Coats, trimmings, muffs, stoles, caps.
Sealine (Rabbit skin plucked and dyed black)	N. Europe, Australia	Trimmings, collars, etc.
Skunk	N. America, S. America	Collars, cuffs, muffs, trimmings.
Squirrel	Siberia, China	Linings, coats, capes, muffs, robes.
Wolf	N. America, Russia, Asia	Robes, muffs, and stoles.

* * *

GAL′AHAD. Of all the knights of the Round Table, according to the Arthurian legends, the noblest was Sir Galahad, whose faith and purity of life gave him powers denied to others. It was this spiritual strength that enabled Galahad to find the Holy Grail, the cup used by Christ at the Last Supper. This sacred vessel, according to the story, had been brought to Britain by Joseph of Arimathea, but when the land fell into wickedness it was hidden away; and the search for it became the noble quest of the knights of King Arthur's Round Table.

> *"My strength is as the strength of ten,*
> *Because my heart is pure."*
> —*Tennyson.*

One day, when the knights were talking of the Holy Grail, the torches in the great hall went out. Across the darkness streamed a band of silver light. Against that, faintly as through a mist, they saw a flush of rose. Only Sir Galahad saw the sacred cup clearly—"all crimson and glowing like a ruby," and heard a voice which said, "Galahad, follow me."

All the knights of Arthur's court swore a vow to live a holy life for a year and a day, while they searched for the lost Grail. Only four returned. Sir Bors and Sir Lancelot had seen the Grail in blessed visions. Sir Perceval had seen it because he was Galahad's friend, and next to him the purest in heart. After long wandering he had found Galahad in prayer in a hermit's cell, "clad in silver armor, and with a face like an angel's."

"Oh, my friend," said Galahad, "the Holy Grail shines always before me, blood red, and glowing like a star, guiding me to Heaven. It gives me victory over every sin and shame and wrong in the world. Come with me."

They went out into a storm, and over a hill top. Galahad ran before, across a bridge which spanned a black marsh, to the sea, and was seen no more. As Perceval knelt, weeping and praying, there came the beam of silver light, and on it the glowing Grail.

In the morning he found Galahad's body, beautiful, thin and worn as a saint's, and buried it by the sea.

"Because of pious zeal, repentance of sins, and goodness," said King Arthur, "three of you have had a vision of the Grail. But only Galahad really found the sacred cup."

The story of Sir Galahad is treated in Malory's 'Morte d'Arthur' and in other medieval romances. It is also the theme of Tennyson's 'Sir Galahad', and 'The Holy Grail' in his 'Idylls of the King'. (For other stories *see* Arthur; Round Table.)

GALILEO (*găl-ĭ-lē′ō*) (1564–1642). The first astronomer to use the telescope for examining heavenly bodies, the discoverer of the pendulum's laws, and the founder of modern physics, was Galileo Galilei (usually known as Galileo). He was born in Pisa, Italy, and died 78 years later, in the year of Newton's birth. With his telescopes, which were the wonder of that age, he discovered the mountains of the moon, four satellites of the planet Jupiter, and the peculiar appearance of Saturn which was later shown to be due to a great ring, or a series of rings, surrounding that planet.

When Galileo was a youth of 19 he saw a lamp in the cathedral at Pisa swinging regularly. He realized—what no one had realized before—that a pendulum swinging to and fro could be used to measure time, and so laid the foundation for the invention of the modern clock (*see* Pendulum). By dropping objects from the leaning tower of Pisa he also proved that falling bodies, however heavy or light, fall at the same rate (*see* Gravitation).

Galileo was a brilliant scholar with a quick and penetrating mind. He held the professorship of mathematics in the universities of Pisa and Padua; but in 1610 he left Padua for Florence, where he lived most of his remaining years.

Galileo made his first telescope with a piece of organ pipe, placing a lens at either end. It only magnified three times, but later he made a telescope that magnified 30 times (*see* illustration with Astronomy). With these he saw the mountains on the moon's surface, found that the milky way was a mass of very faint stars, and discovered the four largest satellites of the planet Jupiter. What he saw through his telescopes also convinced him of the truth of Copernicus' view that the earth rotates on its axis and revolves around the sun, and his ardent support of this view was the cause of difficulties with the church. In 1616 he was given a formal warning, but nevertheless he again provoked the indignation of the church authorities by publishing a dialogue on 'The Great Systems of the Universe', which offended by its misuse of Holy Scripture as well as by its biting satire.

For this publication he was summoned before the Inquisition, in October 1632. No one knows what happened during his examination, but we do know that he uttered a formal recantation of his views and was compelled by the tribunal to live in strict seclusion for the rest of his life. There is a story that as he rose from his knees he whispered defiantly, "Nevertheless it does move,"—referring of course, to the earth; but this is a fiction invented more than a century later.

Galileo achieved his greatest reputation as an astronomer, but it is probable that his chief service to science lay in establishing certain fundamental principles of dynamics, such as the law of falling bodies and the discovery that the path of projectiles is a parabola. He also constructed the first thermometer.

GALVANOM'ETER. An electric current creates a magnetic field around any wire it passes through. This behavior has been made to give us the delicate current-measuring instruments known as galvanometers, after Galvani, the famous Italian discoverer of "current" electricity.

The simplest type of galvanometer consists of a wire mounted at right angles above a compass needle. When a current passes through the wire, the needle is deflected and the amount and direction of the deflection indicates the strength and direction of the current. In more elaborate instruments the wire is wound into a horizontal coil, and the needle is mounted within it to swing in a vertical plane. When the current passes, the needle tends to turn upright, and a pointer attached to it sweeps over a scale to give the reading.

The most sensitive galvanometer is the D'Arsonval. An upright coil of wire is suspended between the arms of an upright horseshoe magnet. When a current passes through it, the coil turns against the resistance of its supporting wires, so that its axis runs more nearly from arm to arm of the magnet. A mirror on the face of the coil reflects a beam of light to a scale to give the reading.

Nearly all automobile dashboards bear galvanometers to show how the battery is working. These instruments are called "ammeters," because their readings are in amperes. Instruments adapted to measure volts are called "voltmeters" (*see* Electricity).

GAL'VESTON, TEX. In 1900 the city of Galveston—which is now one of the largest seaports in the United States and the greatest cotton-exporting port in the world—experienced one of the worst disasters in American history. On September 8 of that year a West Indian hurricane, blowing 120 miles an hour, struck the island on which the city stands, and in a few hours destroyed millions of dollars' worth of property. About 5,000 people were drowned in the huge waves swept in from the Gulf of Mexico.

But Galveston, like Holland, refused to yield to the ocean. The people immediately set about building a gigantic concrete sea-wall, 17 feet above low water, 16 feet thick at the base, and 5 miles long. Houses were lifted on stilts and street-car lines were elevated, while the whole city was raised to the height of this wall by pumping in nearly 20 million cubic yards of sand from the bed of the ocean. And lastly the city was joined to the mainland (a distance of two miles) by a giant causeway and bridge—one of the greatest structures in the history of engineering.

These improvements brought other advantages besides safety from the sea. Raising the level of the city made good drainage possible, and instead of being notorious for cholera and yellow fever, Galveston is now famous as a seaside and health resort, attracting more than a million visitors annually. The giant causeway, which is wide enough for three railroad tracks, besides an interurban electric line and a road for vehicles, has been an invaluable stimulus to business. The new "commission" form of government, which in the crisis was devised to supplant the old inefficient system, proved so satisfactory that it has been widely copied by cities in the United States and Canada (*see* Municipal Government).

Many millions of dollars have been spent by the United States government and by the city on harbor improvements. Granite jetties 12 miles long line the entrance, making it possible to maintain a channel 31 feet deep. Thirty enormous piers give berth room for more than a hundred ocean-going steamships at a time. The chief industrial establishments are cottonseed oil refineries, flour and feed mills, lumber mills, woodenware factories, cement works, shipyards, and ice factories. The island of Galveston, on the east end of which the city is built, is 30 miles long and 3 miles wide. Population, about 45,000.

GAMA (*gä'mä*), VASCO DA (1460?–1524). For more than 60 years the Portuguese had slowly but steadily been creeping farther and farther down the west coast of Africa in their efforts to find a new route to the Indies. The southern end of the continent had been reached in 1488, but for nearly 10 years nothing had been done, and in the meantime Portugal's neighbor, Spain, had entered the race for a route to the East by sending out Columbus. She had, it seemed, been successful in the contest when Vasco da Gama sailed from Lisbon in July 1497, in a final attempt to reach India by the route around Africa. He was selected for the command of the four small vessels—not unlike those of Columbus—because he was "a discreet man, of good understanding, and with great courage for any great deed." He was also "a gentleman of the king's household, and of noble lineage," and a skilled mariner. His voyage to India was a great feat of seamanship. The distance covered was three or four times as great as that to America, and the winds and currents he had to contend with were more difficult than those Columbus encountered. Like Columbus, he also had to contend with the timidity of his men.

After reaching Cape Verde on the west coast of Africa, Da Gama steered boldly for the Cape of Good Hope, called by his men the Cape of Storms. It required all of his resolution to keep his crews to their voyage after they had passed that point. Not if he were confronted with a hundred deaths, he said, would he go back a single yard, and he clapped the leaders of the mutiny into irons. On the east coast of Africa, Da Gama met Indian traders who gave him a pilot for the rest of the voyage. In May 1498, ten months after he sailed from Lisbon, he landed at Calicut, on the west coast of India. His reception by the ruler of the city was not at all friendly, and after seeing enough to convince himself of the immense wealth of the country, he returned home.

When the few survivors—55 out of about 170—arrived in Lisbon in September 1499, they were given a splendid reception. Vasco da Gama was granted the coveted title *Dom*, while his pensions and facilities for trade with the Indies made him one of the richest men in the kingdom.

In February 1502 Dom Vasco da Gama set sail a second time for India, and returned in September 1503, with the first tribute of gold from the East. In spite of the part he had played in gaining a foothold for Portugal in the East, it was not until 1524, when he was more than 60 years old, that he was appointed governor or viceroy of the country. Old as he was he set out energetically to reform abuses in the government, but within a few months after taking office he died.

His successful voyage to the East had brought to his country immense wealth and made her one of the foremost powers of Europe because she now controlled the route to the Indies. As Columbus opened the way to the West and its ultimate wealth, so Da Gama opened the way to the East and its immediate riches.

GANGES (*găn'jēz*) **RIVER.** Born in northern India in an ice-cave beneath the Himalayan snows, Ganges, the sacred river of the Hindus, breaks through the last mountain barrier just above ancient Hardwar. At first scarcely more than a series of broad shoals, long deep pools, and rapids, the river keeps to a southeasterly course through the land of the little talkative Jats, busy in *gram* (chick-pea) and indigo fields, until Cawnpur is reached, that blackest spot on the Indian conscience. For here on a flight of steps, Massacre Ghat, leading down to the Ganges, 600 women and children were killed during the Indian Mutiny of 1857.

When one-half of its journey through the most densely populated region of the world is done, the Ganges is joined by a sister stream, the Jumna, their *doab* (land between two rivers) being irrigated by two very elaborate and costly canal systems fed from the Ganges. The little point of land thrust out into their united swirling waters is, next to Benares, the holy of holies for the Hindus; and here they come by hundreds of thousands each year, to wash away their sins in muddy "Mother Gunga," become deep enough now to bear all sorts of small native craft and navigable throughout the rest of her 1,540-mile journey to the sea.

In a great circle the river sweeps past Benares with every caste and creed of Hindu India swarming like a busy ant-hill down its drab stone *ghats* (steps) into the purifying flood of the Ganges, for the everlasting good of their souls and the cleansing of their bodies. At the head of its delta but still 240 miles from the Bay of Bengal, the Ganges, having dropped nearly to sea-level, slackens its pace, and begins to deposit along its banks the precious load of silt brought down from the Himalayas. When flood time comes this rich natural fertilizer is spread in a thin layer over thousands of acres. In such soil, with a thermometer rarely below 52 degrees and a rainfall varying from 37 to 65 inches, in addition to irrigation from a network of creeks, canals, and the countless fingers which the Ganges stretches across the triangular face of Bengal, vegetation grows as if by magic. Tea, turmeric, wheat and other grains are grown, pepper, quinine, and many costly spices and drugs, oil seeds, cotton jute, three crops of rice a year—everything which feeds and clothes a people and enables it to trade with foreign nations and makes of the Ganges "the river of cities."

Eighty miles from the sea, at Calcutta where smoke belches from factory and mill chimneys, the Ganges (called Hugli here) is choked with shipping. The narrow native canoes with a tiny deck-house and fat barges bearing bamboo cottages look strange enough beside great liners come from "home" and full-rigged sailing ships with low coal-barges tied alongside. An endless chain of black humanity scantily clad goes from barge to ship—bent nearly double under the weight of a heavily loaded coal basket.

The rest of the Ganges delta is a labyrinth of crocodile-infested waterways and ever-shifting river channels in which the native goes to market, calls on his neighbors, and even travels to his fields, with his patient water-buffalo, in a boat, not on a road. In the spring thousands of acres of growing rice are submerged up to the head of the grain, and the whole country looks like part and parcel of the sea. The volume of flood water that comes down then makes short work of embankments; whole cities have been wiped away in a night, and now no permanent structure is ever erected in this district. The barren waste which fringes off almost imperceptibly into the Indian Ocean, across the 165-mile breadth of the delta, is beloved only of the tiger and the one-horned rhinoceros that prowl through its swamps.

GAN'YMEDE. According to a Greek myth, this beautiful youth, the son of King Tros, attracted the notice of Zeus, king of the gods, who determined to make him his cup-bearer to succeed the goddess Hebe, and so sent his eagle to carry him off to heaven. Zeus gave Tros a pair of divine horses and comforted him by telling him that his son was now immortal. Ganymede was a favorite subject of ancient art.

The JOYS *and* PROFITS *of the* HOME GARDEN

WHEN you buy vegetables from the grocer, or flowers at the florist's, you do not get the best products of a garden. Magical gifts are produced there that cannot be bought at any price. But a garden of your own makes you rich in its opportunities to add to your health, your wealth, and your worth. It provides wholesome and profitable exercise for mind and body, tests your perseverance, and builds habits of industry and thrift. Every waste space, no matter how small, though filled with rubbish heaps or overgrown with weeds, is a challenge to the muscle of active boys and girls—yes, and to grown-ups too—to come into the out-of-doors and engage in a lively tussle, a real gardening contest for a prize beyond rubies in value.

GARDENS AND GARDENING. A well-kept garden brings a tingle of pride in ownership and of increased self-respect. Such a garden is a sign of good citizenship. There should be an honor flag over every garden in peace as well as in war, for the proper feeding of the people has become a national problem even in the United States, as it has long been in European countries.

Abraham Lincoln said, "Ere long the most valuable of all arts will be the art of deriving a comfortable subsistence from the smallest area of soil. No community where every member possesses the art can ever be the victim of oppression in any of its forms. Such community will be alike independent of crowned kings, money kings, and land kings." Food experts tell us that if every citizen of the United States were to make full use of his garden space, the annual products would take the place of at least 120,000 tons of sugar, 1,000,000 tons of flour, and 1,200,000 tons of meat. This includes the use of fresh vegetables and the surplus preserved, canned, or dried for winter use. On a plot of only 10 by 25 feet with an expenditure of less than $5 for seed and fertilizer boys and girls have supplied a family of four with vegetables throughout the season, representing a cash value of $30 to $60. If anyone should tell you that there was that much money buried under a rubbish heap, how eagerly you would devote your time to searching for the dollars!

The Miracle of Growth

Miracles are wrought in a garden if we have eyes to see them. The germ of plant life expanding under the friendly charm of sunshine and rain, air and soil, becomes a full-grown plant, bearing its gifts of beauty and usefulness. No investment on the stock market can rival nature's return, for she gives back a "hundred fold." You plant a tiny seed, and a few weeks later you harvest a basket of red ripe tomatoes, a big head of crisp tender lettuce, or a three-pound head of cabbage. From seeds no larger than a thumbnail, long vines spread over the ground, and when the flowers droop, tiny green balls develop into long green cucumbers, crooked-necked summer squashes, golden pumpkins, or tempting watermelons. A bushel of corn grows from a pocketful of kernels and you can bring to the garden a few handfuls of potato cuttings and cart away bushels of large fleshy tubers. If it is flowers you plant, the returns in beauty are beyond the measure of bushel baskets and dollar signs.

You may start your gardening in the fall with fertilizing and plowing or spading the land. Then plan your garden during the winter. If you intend to furnish your own home with fresh vegetables, you will want to plant small amounts of many different kinds, both early and late, so as to furnish a good variety all during the growing season; but if you intend to market your garden products it is usually the best plan to have only a few varieties so that you can get the best results. The vegetable chart at the end of this article may be helpful in making a selection. Seed-testing should also be done before time to plant in the spring.

Helping the Roots Along

The seed bed should be carefully prepared, for it is the storehouse of the necessary plant foods. After plowing or spading, the soil must be pulverized so that the roots can work freely through it in their search for nourishment. On small plots this can be done with hoe and rake. If the ground is low and level it may be well to divide the garden into small raised plots with ditches between so the water will drain off, for wet soil is cold and air is shut off from the root feeders. Some moisture is necessary, because the plant foods are dissolved in the water taken up by the plant. During hot dry weather the ground will dry out too rapidly if it is allowed to harden and crack on top. The moisture is conserved by keeping the top soil well worked (*see* Capillary Attraction).

Long before seeds can be planted in the outdoor garden, they can be sprouted indoors or in hotbeds and cold-frames. A hotbed is made by covering a few inches of fine loam over a deep layer of fermenting compost or manure. The fermenting process warms the soil. The cold-frame is a garden under glass which protects the early plants from frost. Plants may be started in a hotbed or cold-frame and then trans-

THE TRUTH ABOUT "CABBAGES AND KINGS"

Do you remember the "cabbages and kings" that the Walrus talked about in 'Alice in Wonderland'? Perhaps it sounded like nonsense. But hear what Lincoln had to say on the subject of cabbages—serious garden cabbages like these—and kings. He said that the man who gets his living in this way from the soil becomes "alike independent of crowned kings, money kings, and land kings."

planted to the regular garden plot. Cabbages, tomatoes, celery, lettuce, and many other common vegetables may be started in this way to take full advantage of the growing season.

Transplanting should be carefully done or the growth of the plant will be disturbed. A place is made in the ground with the hand or a sharp stick to allow plenty of room for the roots of the young plant, and if some soil can be removed with the roots, so much the better. Transplanting is best done in the evening, otherwise the plants must be shaded from the hot sun. Water the plants after they are set out.

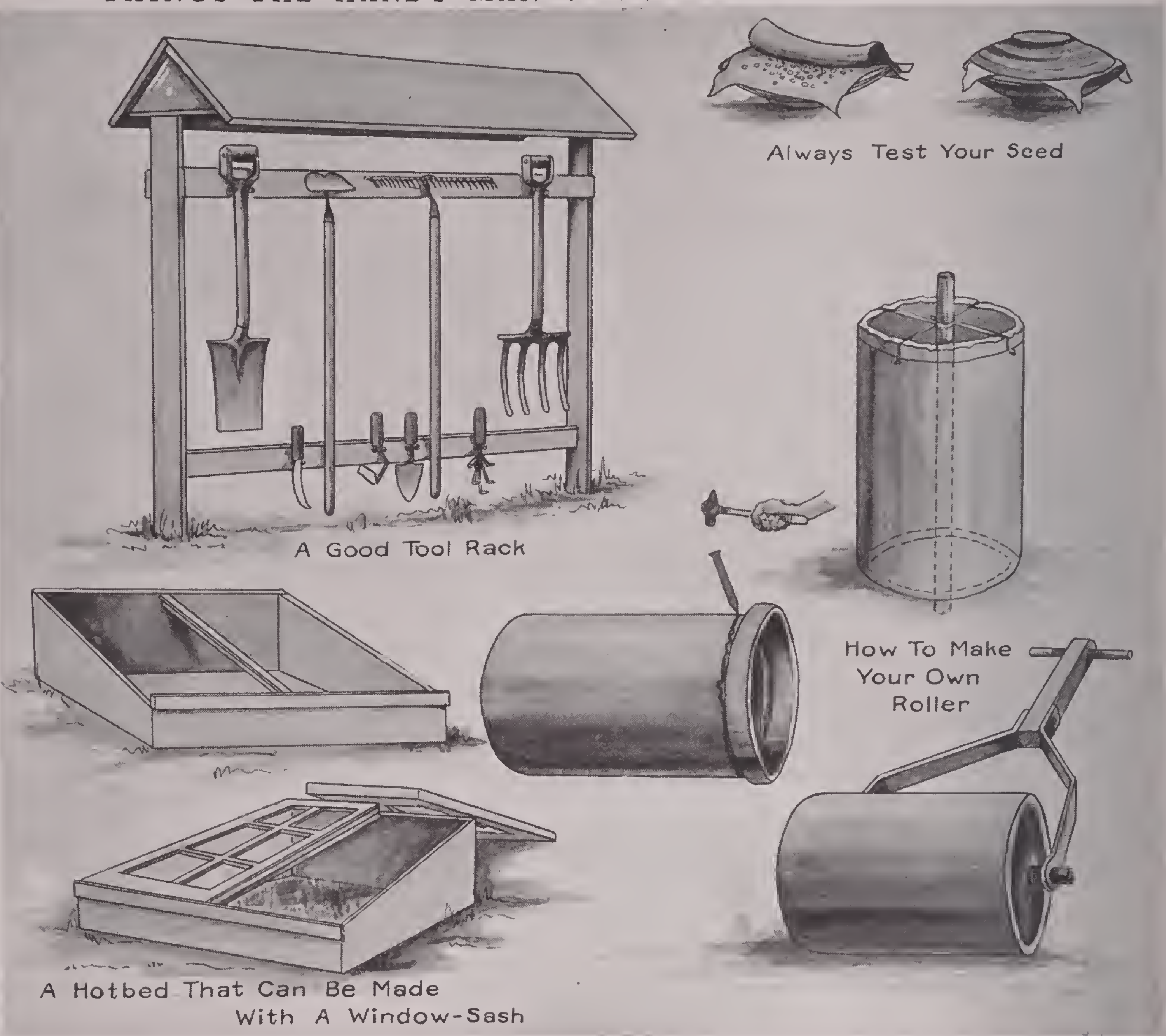
Defending the Plants from Their Enemies

Seeds are planted in the garden in straight rows or regularly spaced hills with markers at each row to show what has been planted there. Then comes the time of waiting and watching for the first green sprout. As soon as your garden is up, or even before, you must be on the watch for insect and fungus pests (*see* Spraying). Cultivating or hoeing is necessary to keep down the weeds between the rows, and weeds in the rows must be pulled by hand to keep them from taking the moisture and plant food. Thinning out the plant rows may be necessary to leave room for growth.

Vegetable growing on a large scale, called market gardening or truck gardening, is an important industry, especially near city markets. Vegetables grown in the South are shipped in refrigerator cars to Northern markets, and growing vegetables under glass all winter long has become a large industry. The great size of this industry is shown by the fact that in a single year, recently, 33 states marketed vegetables worth $125,000,000.

Home gardens are less profitable in money returns to the amateur gardener, but they yield large dividends in the way of pleasure. Who gets more joy out of life than the enthusiast about flowers, who is ever trying to make two petals grow where one grew before and develop a new variety remarkable for its delicate coloring, its graceful shape, or its superb proportions? No type of flower garden is more delightful than the old-fashioned garden, with its fragrant sweet alyssum and mignonette along the borders of the worn brick walks; its tall, sturdy cockscombs and sunflowers and hollyhocks looking over the fence; its clumps of defiant tiger lilies and pale peonies, its sweet-scented beds of phlox and petunias and clove pinks, its martial ranks of blue flags and its vivid rockets of scarlet

THINGS THE HANDY MAN CAN DO ABOUT THE GARDEN



The first thing to build for your garden is a good tool rack so that you can always find your implements when you want them. You can see from the picture how it should be built. The next thing will be a roller, to help break up lumps of dirt and smooth the ground. You can make this with a length of sewer pipe. You can cut off the flange with a hammer and cold chisel by nicking the pipe all around, and when the cut is deep enough, breaking off the flange with the hammer. Then the pipe should be set upright, and an iron pipe inserted through the middle, with wiring to hold it in place, so that it protrudes at both ends. When these preparations have been made, fill the inside of the pipe with concrete. When it has hardened, the roller is ready, and all you need to do is put a handle on it. The storm windows that come off the house in the spring can be used to cover hotbeds, as shown. The pictures show how to build a frame to hold them. This done, you are ready for planting. You can test seed before planting by placing a few samples between damp cloths, and keeping the cloths moist and warm within two bowls. If the sample seed sprouts within a few days, you can be sure that the seed is good.

sage—a delight from the time the first crocus opens in the grass until the last aster withers at the touch of frost.

Commercial floriculture embraces two main divisions, the cultivation of plants for indoor and outdoor use, and the growing of cut flowers. Roses, violets, carnations, and chrysanthemums, in the order named, are the most important cut flowers. In the neighborhood of the great cities particularly, the growing of cut flowers for the market has been so specialized that growers will devote themselves each to a single flower. On the Hudson River there are even whole communities largely devoted to violet growing. Such enterprises in the hands of experts are very profitable.

But the rewards of home gardening are much bigger than mere dollars and cents. As one enthusiast says, "Your chief joy in your garden will not be in the vegetables that you eat, nor in the flowers that you pick, but in the satisfaction of causing things to grow. You will enjoy the companionship of things that are real and clean. You will come to know the common and the little things. Just to have handled the new earth, and to have sown the seed, and to have thought about the garden at morning and at night—this is worth the effort. You have come nearer to nature. An interest in plants is part of our culture, akin to the interest in books and pictures and music." (*See also* School Gardens.)

WHAT AND WHEN TO PLANT IN THE VEGETABLE GARDEN *

The dates of planting shown in this table are approximate for the United States and will vary with the season. The dividing line between North and South is considered to be the continuation of the southern boundary of Pennsylvania or about the 40th parallel of latitude. Unless you have a large plot do not attempt to grow all the vegetables in this table. Usually the small home gardener will find it more advisable to buy plants of such vegetables as asparagus (preferably 1-year-old roots), cabbage, cauliflower, celery, eggplant, pepper, tomato, etc., than to grow them himself.

Kind of Vegetable	Seeds or Plants Required for 100 Feet of Row	Time of Planting out of Doors (N = North; S = South)	Distance between Plants	Depth of Planting	Time Required to Secure Crop after Planting
Asparagus	60 to 80 plants	Early spring	2 ft.	5 to 6 in.	1 to 3 yr.
Beans, bush (kidney and lima)	1 qt.	N— April to July S— Feb. to Apr. (Aug.)	2 to 4 in.	1 to 2 in.	40 to 65 da.
Beans, pole (kidney and lima)	4 oz.	May and June	18 to 24 in.	1 to 2 in.	50 to 80 da.
Beets	1 oz.	Early spring	4 to 6 in.	½ in.	60 to 75 da.
Brussels sprouts	¼ oz.	N— May to June S— Jan. to July	1½ to 2½ ft.	½ in.	100 to 125 da.
Cabbage, early	⅓ oz.	N—Mar.-April (start in hotbed Feb.) S— Oct. to Dec.	14 to 18 in.	½ in.	110 da. from plants
Cabbage, late	⅓ oz.	N— May and June S— June and July	18 to 24 in	½ in.	150 da. from plants
Carrots	1 oz.	Early spring, May 15 to June 15	3 to 6 in.	¼ to ½ in.	80 to 110 da.
Cauliflower	¼ oz.	May 15-June 15 (hotbed in March)	1½ ft.	½ in.	100 to 130 da.
Celery	½ oz.	May for early crop (start under glass in Mar. or April) July for late crop (sow seed in May)	4 to 8 in.	⅛ in.	160 to 170 da. from seed 90 to 100 da. from plants
Chard (Swiss)	2 oz.	Early spring to June 15	4 to 6 in.	½ in.	To middle of summer
Corn, sweet	2 to 3 oz.	Early spring	12 to 18 in.	½ to 1 in.	60 to 100 da.
Cucumber	½ oz.	N— May to June S— Mar. to April	4 to 5 ft.	½ to 2 in.	60 to 80 da.
Eggplant	¼ oz.	N— June S— Jan. to May	2 to 3 ft.	½ to 1 in.	120 to 150 da.
Kohlrabi	½ oz.	N— April to June S— Sept. to Mar.	6 to 8 in.	½ in.	75 to 120 da.
Lettuce	½ to 1 oz.	N— April to Aug. S— Oct. to Mar.	12 in.	$\frac{1}{16}$ to ½ in.	60 to 90 da.
Melon, muskmelon	½ oz.	N— May 15 to June 15 (sow seed under glass April 15) S— Feb.	4 ft.	1 to 2 in.	110 to 130 da.
Melon, watermelon	1 oz.	N— May 15 to June 15 S— Mar. to May	7 to 10 ft.	½ to 1 in.	115 da.
Okra, or gumbo	1½ to 2 oz.	N— May to June S— Feb. to April	14 to 36 in.	1 to 2 in.	115 da.
Onion, seed	½ oz.	N— April and May S— Oct. to Mar.	2 to 4 in.	¼ in.	135 da.
Onion, sets	1 to 1½ qt.	N— Early spring S— Fall and Feb.	2 to 4 in.	½ in.	60 da.
Parsley	¼ oz.	N— Last of Mar. to 1st of April S— Sept. to May	3 to 6 in.	½ in.	95 to 120 da.
Parsnips	½ oz.	April and May	3 to 4 in.	½ in.	125 to 160 da.
Peas	1 qt.	N— Early spring S— Dec. to April	10 to 15 in.	1 to 2 in.	60 to 80 da.
Pepper	¼ oz.	N— May and June (start early plants under glass in Mar.) S— Last of Mar.	18 to 24 in.	½ to 1 in.	100 to 140 da.
Potato, sweet	3 lb. (or 75 slips)	May and June (start in hotbed in April)	14 to 18 in.	3 in.	140 to 160 da.
Potato, white	5 to 8 lb. tubers	N— Mar. to June S— Jan. to April	12 to 18 in.	4 in.	80 to 140 da.
Pumpkin	1 oz.	N— May to June S— April and May	2 plants in hill 8 to 10 ft.	1 to 2 in.	110 to 140 da.
Radish	1 oz.	N— Mar. to Aug. S— Sept. to April	1 to 2 in.	¼ in.	30 to 40 da.
Rhubarb	25 to 50 roots	N— Early spring S— Fall	2 to 4 ft.	2 to 3 in.	1 to 3 yr.
Rutabaga	½ to 1 oz.	N— June to July S— Aug. to Sept.	8 in.	½ to ¾ in.	70 to 100 da.
Salsify	1 oz.	Early spring	3 in.	½ to 1 in.	130 to 160 da.
Spinach	1 oz.	N— April 1 to Sept. 15 S— Aug. to Oct.	6 to 8 in.	¼ in.	50 to 60 da.
Squash, bush or early	1 oz.	N— May S— Feb. to Mar.	3½ to 4 ft.	1 in.	60 to 75 da.
Squash, late	1 oz.	N— May S— Feb. to Mar.	6 to 10 ft.	1 in.	125 to 150 da.
Tomato	¼ oz.	N— May to June S— Jan.	2½ to 4 ft.	½ in.	130 to 150 da.
Turnip	½ to 1 oz.	Early spring	2½ to 8 in.	½ to ¾ in.	40 to 60 da.

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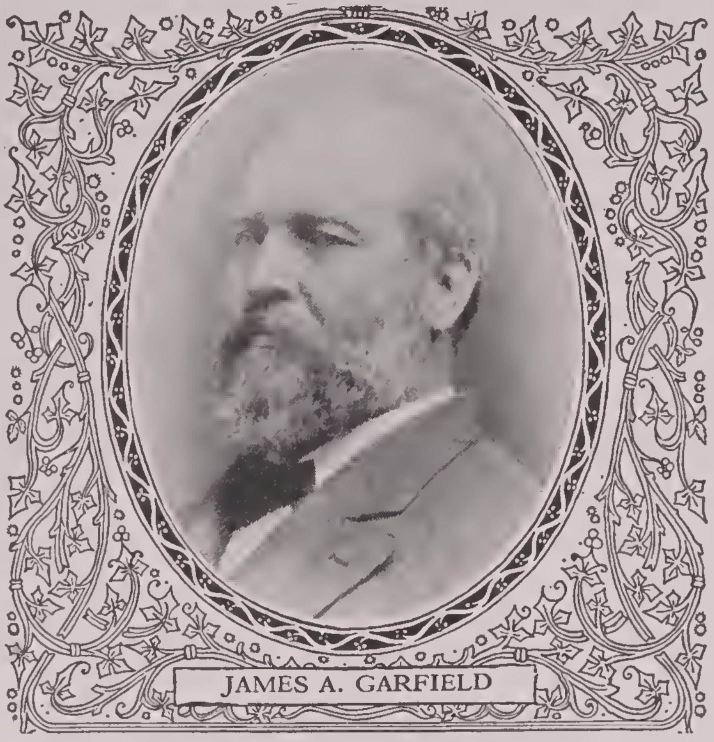
AMERICA'S SECOND MARTYRED PRESIDENT



JAMES A. GARFIELD

GARFIELD, JAMES ABRAM (1831–1881). When Garfield was assassinated on July 2, 1881, many comparisons were made between his life and that of Abraham Lincoln, the first "martyred president." Both were "self-made men." Both were born in log cabins, and endured in youth the privations which accompany farm life on the frontier—Lincoln in Illinois, Garfield in Ohio. As a young man, Lincoln took a flatboat down the Mississippi River; Garfield at about the same age served on a canal-boat on the Ohio and Pennsylvania Canal. Both were eager for an education; but while Lincoln attained his knowledge by studying at night alone, Garfield was able by hard work to obtain a college education.

Though Garfield was a tireless reader from his earliest days, reading over and over again every book he could borrow, his youthful ambitions were not along the lines in which he made his name famous. One of the books he read and reread, beside the flickering flame of the wood fire in the log cabin, was a book of sea stories. These so caught his youthful fancy that he resolved to become a sailor. At 17, with his mother's consent, he tramped across the country to Cleveland, and tried to ship on a lake-boat. The captain drove him from the deck, and the disappointed lad had to content himself as stated with a job on a canal-boat, driving the mules along the towpath and acting as deck hand. A lucky attack of sickness sent him home, and his ambitions were turned to higher fields. By the time he recovered, his mind had been set on becoming a teacher, and he started off to school with a slender capital borrowed from his widowed mother. After his first term he needed no more help from her, for he worked his way through the Eclectic Institute at Hiram, Ohio (now known as Hiram College), by farm labor and carpentering. When he was ready to enter college his choice fell on Williams College, because its president was the celebrated Mark Hopkins, for whom Garfield had the greatest admiration. Garfield used to say, "A log with a student at one end and Mark Hopkins at the other is my ideal college." He was graduated from Williams in 1856.

Garfield as a College President

When Garfield became, at the age of 26, president of the Ohio College where he had taken his preliminary work, he proved himself a teacher of the same type as Mark Hopkins—a man of unbounded zest for truth, limitless curiosity, and intense interest in his pupils. Had he remained in this work, he would doubtless have become one of the country's great educators. It is interesting to know that two of his sons also went to Williams College, and one of them, Harry A. Garfield, became its president. This son served during the World War of 1914–1918 in the important post of fuel controller. The second son, James R. Garfield, was secretary of the interior under President Roosevelt.

Garfield's rise was rapid. Within six years after his graduation he had been president of Hiram College, Ohio state senator, major-general in the United States army, and representative-elect to the United States Congress. A more rapid rise than this has been made by no American statesman, and the variety of the positions shows that he himself practiced his advice to young men, to "be fit for more than the one thing you are now doing."

Service in War and Public Life

While teaching at Hiram College, Garfield studied law; and from the time of his admittance to the bar, in 1859, until his death, he was continually engaged in politics, with the exception of the two years that he served in the field in the Civil War.

Though he was a brave soldier, and in 1863 was commissioned major-general for his bravery at the battle of Chickamauga, President Lincoln thought Garfield would be of greater use to his country in Congress. So he resigned his commission, in December 1863, and took the seat in the House of Representatives to which he had been elected the year before. There he made himself especially useful in the committees on military affairs and on finance. He served for 17 years in the House—until his election in 1880 to the Senate from Ohio; and it has been said that his speeches in Congress give a connected history of the times. Garfield was an impressive orator, because he had a powerful voice, great personal magnetism, and a straightforward style of address which aroused enthusiasm and carried conviction.

The triumph of his political career came when he unexpectedly received the Republican nomination for the presidency in 1880. The party was divided that year into two factions—the "stalwarts," who wished Grant to be nominated for a third term, and the "half-breeds," who opposed Grant and for the most part favored James G. Blaine. Neither side would yield, and after a long fight they compromised on James A. Garfield, a "dark horse." Because Garfield was a "half-breed," Chester A. Arthur, an uncompromising "stalwart," was made the candidate for the vice-presidency.

His Personal Appeal to the People

In the campaign which followed, Garfield spoke in his own behalf, the first time that a presidential candidate had thus appeared before the people. His was victoriously the overwhelming vote of 214 electorial votes to 155 given to General Hancock, the Democratic candidate.

Garfield never had a chance to show his ability as chief executive of the country. Four months after his inauguration he was shot by Charles Guiteau, a disappointed office-seeker. The tragedy was the result of the bitter quarrel between the "stalwarts" and "half-breeds" over appointments to office, a quarrel which absorbed all of the president's time before he was shot.

The day of the tragedy was to have been a red-letter day in the president's life. He was on his way back to his beloved college, Williams, from which he had been graduated 25 years before, to join in the reunion of his classmates. The assassin's bullet struck him down as he was walking through the railway station in Washington to his train. Garfield lingered between life and death for weeks and finally died Sept. 19, 1881. He was the 20th president of the United States, the second who was assassinated, and the fourth to die while in office.

GARIBAL'DI, GIUSEPPE (1807–1882). "The third time's the charm," according to the old saying, but it was the fourth attempt which brought Giuseppe Garibaldi, the knight errant of Italian unity, his signal success and enduring fame. Twice he joined in vain attempts to free Italy from Austrian rule, first in 1834 and again in 1848—and both times he was forced to flee from the country. In 1834 he escaped to South America with a sentence of death hanging over him. There he stayed for 14 years, taking part in the civil wars of Brazil and Uruguay, earning for himself the title of "Hero of Montevideo," and forming the "Italian Legion" which was later to help emancipate the homeland.

Returning to Italy he took part in the unsuccessful Revolution of 1848, and commanded the forces of the short-lived Roman Republic which he and Mazzini set up. When this collapsed, Garibaldi escaped in a wonderful retreat through central Italy, pursued by the troops of four countries. This time he sought refuge in New York, where he engaged for several years in trade and commerce and succeeded in accumulating a small fortune.

His third opportunity came in 1859, when Sardinia-Piedmont, with French aid, went to war with Austria. Garibaldi's Alpine infantry was victorious in the north, but further advance was checked by the peace made with the Austrians at Villafranca by the faint-hearted Napoleon III.

Secretly encouraged by Cavour, the great prime minister of Piedmont, Garibaldi and his "Thousand Red-Shirts" set forth in 1860 for Sicily, on one of the greatest filibustering expeditions in history and one that eventually gave to his king, Victor Emmanuel, the remaining half of Italy. Within a few short weeks after landing and assuming in the name of Victor Emmanuel the dictatorship of Sicily, Garibaldi had driven all the Neapolitan forces out of the island with little loss of life to his own men. He had come into possession of money, arms, boats, stores of all kinds, had increased his army to some 25,000 men, and had become the idol of all Sicily, to whom the red shirt of his warriors became the proudest badge of men and women. He had so completely aroused Italy that each town poured forth its young and old to join his victorious standard.

He Enters Naples in Triumph

When Garibaldi crossed from Sicily to the mainland, in August 1860, his march from Reggio to Naples resembled a triumphant procession. It was only necessary for Garibaldi to appear before a town for it to surrender. At one place, with a few hundred men back of him, he ordered 12,000 Neapolitan troops to surrender, and they immediately did so, for his cause was really their cause. He entered Naples in the midst of enthusiastic crowds, wildly cheering and singing the national anthem, from now on called the 'Garibaldi Hymn'. In accordance with the votes of the people, Garibaldi handed the kingdom of Sicily and Naples over to Victor Emmanuel, whom he acknowledged as the king of Italy.

Garibaldi himself, although he was the hero of Italy, was the most difficult problem that the new government of united Italy had to face. He never forgave Cavour for the cession of Nice—Garibaldi's birthplace—to France as the indispensable price of Napoleon III's aid to Italian unity. Only with difficulty was he restrained from his mad plan to attack Rome which was under the rule of the pope, although he knew that an attack on it would bring against the struggling kingdom of Italy the forces of both France and Austria—her friend and enemy. Twice the government was forced to send troops after Garibaldi and take him prisoner, in 1862 and 1867. When finally Italian troops entered Rome, in 1870, Garibaldi had no part in it, for he was at that time helping the new-born republic of France in its despairing struggle against Germany.

When the Franco-German war was over he retired again to his island home of Caprera, where he spent the rest of his life receiving admiring visitors and attempting to stir up the people to establish a republic in Italy. He was easily worked on by unscrupulous agitators who sought the overthrow of the united monarchy he had helped to establish. Fortunately the plots did not succeed, and Garibaldi today is regarded as the hero of Italian unity.

GARRISON IN THE OFFICE OF THE 'LIBERATOR'

How this picture carries us back to those troubled times before the Civil War, when young William Lloyd Garrison in his humble printing office was producing the little paper that proved such a tremendous force in driving slavery out of the United States! What a fine earnest face he has, and what a good head! While the two other men are putting the little paper to press, Garrison is "setting up" an article for the next issue. By working 16 hours a day they managed to publish their little four-page "sheet" nearly every week, in spite of the most violent opposition from slavery sympathizers.

GARRISON, WILLIAM LLOYD (1805–1879). "I will be as harsh as truth and as stern as justice. I am in earnest—I will not equivocate—I will not excuse—I will not retreat a single inch—and I will be heard."

Imagine if you can the anger of the defenders of slavery, in January 1831, when the ardent young abolitionist, William Lloyd Garrison, hurled this challenge at them in the first issue of his paper, the *Liberator*, and further declared that he would not cease his agitation—

> . . . till Afric's chains
> Are burst and Freedom rules the rescued land.

And yet why should anyone fear this impetuous young reformer? He was poor, unschooled, and without influential friends; and he had recently been in jail for expressing his violent anti-slavery views.

Garrison had inherited from his mother a determined will and was used to battling with the world, for he had been forced to begin his struggle as a breadwinner when he was only nine years old. After trying shoemaking and cabinetmaking, he had found his lifework in the printing office of his native town of Newburyport, Mass. Here he gained the education that he had no chance to acquire at school.

At the age of sixteen he wrote an article and sent it to the editor unsigned. We can imagine his joy the next morning when the editor gave it to him to set up in type, thinking that it was from one of the leading politicians of the state. With this encouragement Garrison went on until he, too, became a newspaper editor. From the first he had been interested in the cause of the slaves, and he determined to devote his life to working for their freedom.

The anti-slavery cause was not a popular one in those days. Garrison could not get halls for his meetings; churches were closed to him; the state of Georgia offered a reward for his arrest and conviction; and his mail was filled with threats of death. In 1835 a mob dragged him through the streets of Puritan Boston with a rope about his body. But still Garrison kept on. Though the *Liberator* gained little financial support, Garrison and his partner were determined to keep the paper alive so long as they "could live on bread and water or find employment for their hands." By working 16 hours a day they managed to publish their little four-page paper nearly every week.

In 1832 Garrison organized the New England Anti-Slavery Society, the first of such societies in the United States; and the following year he went to England to consult anti-slavery leaders in that country, which was just on the point of passing a law, freeing the slaves in its colonies. On his return he took a leading part in founding the American Anti-Slavery Society, of which he later became president. A brilliant band of orators and writers was gradually attracted to this organization, the most distinguished of whom was the eloquent Wendell Phillips. From Phillips the society gained not only the advantage of his magic tongue, but also a flavor of respectability as the result of his social standing.

The nickname of "abolitionists" soon came to be applied to all those anti-slavery advocates, from the views of the extremists, who demanded the immediate abolition of slavery without regard to the United States Constitution and without compensation. From the laws of man sanctioning slavery they appealed to the "higher law" of God and nature. Garrison even went so far as publicly to burn the United States Constitution and denounce it as a "covenant with hell and an agreement with death." No man did more to end slavery in the United States than did Garrison; but it is also true that no man did more to make peaceful compromise impossible and war inevitable, except the no less extreme and fanatical supporters of the cause of slavery in the South.

But the triumph of Garrison came at last in 1863 when the *Liberator* printed Lincoln's Emancipation Proclamation, and two years later when he chronicled the passage of the 13th amendment to the Constitution, forbidding slavery in the United States. Feeling that its work was done, Garrison then discontinued his paper. As Lowell wrote—

In a small chamber, friendless and unseen,
  Toiled o'er his types one poor, unlearned young man;
The place was dark, unfurnitured and mean,
  Yet there the freedom of a race began.

Now that work was done and the freedom for the slave won. For a time Garrison's life seemed empty. But he was a born reformer and soon turned his attention to other fields. During the last years of his life he gave his support to the causes of woman suffrage, temperance, and peace.

A MAGIC CITY *and Its* FAMOUS SCHOOLS

The Great Steel Center that Sprang up in a Night, and the Development of the Gary Plan for Making Education "Interesting" to Boys and Girls

GARY, IND. In 1906 the site of Gary was a waste of sand-dunes and marshes. Today it is the world's greatest steel-producing center, with an area of more than 20 square miles, with scores of enormous industrial plants, and a population that ranks it first of the cities of northwestern Indiana.

The spectacular creation of this infant city was the act of the United States Steel Corporation, which chose this site for the erection of the huge plant of the Indiana Steel Company and other subsidiary enterprises, now employing tens of thousands of workmen. It owes its existence to its situation at the head of Lake Michigan, about 25 miles from Chicago midway between the iron ores of the north and the coal mines of the south, with the advantages of cheap water transportation both for its raw materials and its manufactured products. It was named for Elbert Henry Gary, head of the United States Steel Corporation. Population, about 55,000, of which about two-thirds are of foreign birth.

About Gary's Famous Schools

Important as it is industrially, Gary is almost as well known for its interesting school system. There is no other city in the United States, perhaps no other city in the world, whose schools were so much talked about, so much written about, and so much visited, within the years 1910–1920. During this period there was scarcely an American magazine of any sort which did not have one or more articles on the "Gary plan." Meanwhile, the Gary plan had attained so much popularity that in many cities "Garyizing" the schools had become an issue upon which school boards were elected and superintendents of schools appointed or dismissed.

There is probably nothing in the Gary plan which is not to be found in many other less-heralded school systems. Yet probably no one system has attempted to bring together so many features which thoughtful men and women have long been saying must be given a place in the modern school. Some of these are designed to bring children into contact with vital social interests and institutions, others to give them some direct preparation for earning a livelihood. Since an important feature of the Gary plan is housing in one building all grades from the kindergarten through the high school, it is impossible to carry out completely the idea of Supt. William A. Wirt, author of the Gary plan, except in the larger schools where all grades are to be found.

Here we find, instead of the old-fashioned style of schoolhouse made up chiefly of classrooms, a building in which about half the space is used for classrooms and the other half for kitchens, sewing-rooms, studios, laboratories, auditorium, gymnasium, and shops in which are taught such trades as carpentry, cobbling, forge and machine work, painting, pottery, printing, and sheet metal work. In many schools where such special rooms are provided, they are used almost exclusively by the high-school students; in Gary they are used by pupils of all grades.

Importance of Play in the Gary System

The Gary school plan affirms that it is even more important that children should have opportunities to play, in order that they may develop strong and healthy bodies and learn to get on with one another, than that they should learn the multiplication table or grammar. In few cities are the schools provided with such large playgrounds and such large athletic fields as the schools in Gary. Some of the Gary schools have playgrounds and athletic fields covering several acres.

The program of the Gary schools is so arranged that boys and girls who wish to work during school hours, or to take private lessons in some subject not taught in the school, such as music or religion, may do so. In order to give time for work, for play, and for outside lessons, the Gary schools have a seven-hour instead of a five-hour school day. This provides two hours each day which may be used for play, for work or outside lessons, and five hours for the ordinary studies and activities of the school.

The Gary plan places great importance upon regular daily auditorium exercises. The purpose of the auditorium exercises is to give the children social training, to teach them how to conduct themselves on such occasions in public, and to create wholesome and uplifting interests. Several grades often occupy the auditorium together. Sometimes the exercises consist of exhibitions of the work of a particular class or of music, travel talks, or motion pictures. The corridors are used for exhibitions of geographical and historical models, pictures, school work, etc.

Little Democracies within Four Walls

The discipline in the Gary school aims to prepare children to become citizens in a democracy. The discipline is therefore based upon the principles of democracy and freedom, and cultivates intelligence, liberty, and self-control. Pupils leave their seats when they wish without asking the teacher's permission. They move freely about the rooms and in the corridors. Responsibility is placed upon the pupils not only by this discipline, but by having them assist the teachers in the laboratories and in the shops.

The Gary schools aim to serve "all of the people all the time" as far as possible. Some of the ways in which this is done are: (1) by keeping the schools open all the year round; (2) by keeping the schools open on Saturday for children who are behind in their work or who are especially interested in any particular type of work; (3) by evening extension classes for adults; (4) by using the school as a social center for the entire community.

Superintendent Wirt claims that the Gary plan shows how it is possible to offer these unusual advantages without any greater expense than that of the ordinary school system. Expenses are reduced in several ways. The Gary plan practically eliminates supervisors who are specialists in the various subjects. It claims to decrease expenses by housing in one building all the grades from kindergarten through high school and making each school seat and desk serve two children instead of one. This is done by dividing each class into two sections or platoons. Platoon "A" occupies the seats and desks in the recitation room while Platoon "B" is sent to the laboratory, shop or playground, and vice versa.

Weaknesses of the Gary System

The first reports of the Gary plan published were uniform in their enthusiasm and praise. After a time a number of reports appeared which, though commending many things in the Gary plan, criticized much of the work in the schools. A report of the General Education Board praises the following things: (1) the large, generous, and modern conception of education upon which the Gary plan is based and the courage of the Gary school authorities in undertaking to put such a conception into effect; (2) the manner in which the schools are organized; (3) the democratic discipline; (4) the excellent spirit pervading the schools. It criticizes the work of the schools adversely as follows: "The execution of the plan is very defective with respect to administration and supervision of the teaching and pupils' work. The absence of proper accountability results in slip-shod work. Poor spelling, arithmetical inaccuracies, and grave omissions pass unchallenged." Another critic points out that adequate supervision would remedy the dirt and the indifference to proper light conditions and the resulting injury to pupils' eyes in many rooms. The dangers of attempting to make one seat serve two pupils are great. High school pupils sat with their knees hunched up toward their chins and their bodies twisted in small grade school seats. He comments also on numerous cases of disorder and inattention.

Probably the highest praise which the Gary schools deserve may be summed up by saying that they have shown how much more the schools of tomorrow must do and can do for the children than the schools of the past have done. It required no small amount of courage to experiment in establishing such thoroughly modern schools. The defects of the Gary schools are not due to faults in the ideas upon which they are based, but rather to the fact that in carrying out any new plan, those responsible for it and understanding it must be constantly on hand to supervise its execution according to clear and definite standards.

GAS. The most familiar example of what we mean by gas as a form of matter is the air, which is a mixture of oxygen, hydrogen, nitrogen, and other gases. Many gases are invisible, tasteless, and without smell, and can be detected only by their effects. The existence of air, for example, is readily observed when a current of it extinguishes a match, or when you feel it blowing against you. The gas which comes from the exhaust of an automobile may usually be seen, because it is slightly colored; but even if it had no color you could detect it by its unpleasant odor.

Gases have small densities as compared with liquids and solids, which is another way of saying that they are light in weight for the space they occupy. Water is 800 times denser than air, and air in turn is more than 14 times heavier than hydrogen.

Gases are indefinitely elastic; that is, they have no definite surface boundaries but tend to expand indefinitely and occupy any space within which they may be confined. The molecules of which they are composed are supposed to be much farther apart than those of liquids or solids. These molecules are in ceaseless rapid motion, bounding and rebounding from each other like rubber balls. When they strike the walls of the vessel which contains them, they produce a constant stream of tiny blows on all parts of it, thus exerting a pressure which we utilize to drive our automobiles and to send bullets and shells flying from guns. This explanation of the action of gases is called the *kinetic theory* of gases.

The pressure of a gas increases as the size of the container is reduced. For practical purposes, it may be said that reducing the volume one-half doub'es the pressure, or to put it the other way around, "the volume of a gas varies inversely as the pressure." This is called Boyle's law, after Robert Boyle, an English scientist of the 17th century who first stated it.

If two gases be brought together they will gradually mix with each other, even though the mixing has to be done in opposition to gravity and through a thin membrane or piece of unglazed porcelain. Many gases dissolve in liquids. For example, ammonia and carbon dioxide readily dissolve in water. Air also dissolves in water to a certain extent, and thus fishes get the oxygen which they breathe.

The gaseous form of substances that are ordinarily liquid or solid, such as water, alcohol, and gasoline, is usually spoken of as vapor. Strictly speaking, however, there is no physical difference between such a gas as oxygen, for instance, and water vapor; for we know that all gases may be changed into the liquid form if they are put under sufficiently great pressure and the temperature is sufficiently lowered. Even air has been liquefied (*see* Liquid Air).

With the growing importance of gases in various commercial processes, and their increased military value as shown in the World War of 1914–18, this branch of chemical industry has become one of vital importance. Immense quantities of compressed gases are manufactured and shipped all over the country, usually reduced to liquid form and held in exceedingly strong containers. (*See* Air; Atoms and Electrons; Molecule; also articles on various gases, Acetylene, etc.)

HARNESSING EXPLOSIONS

The Story of the Gas Engine

THE automobile hums over streets and highways, the swift motor boat sputters over lakes and rivers; the airplane roars its way through the clouds; the softly chugging submarine pierces the waves; and on the quiet farm sounds the whirr of machinery—pumping water, churning butter, lighting the house and barnyard at night with a blaze of electricity. All these are singing the great song of the gas engine—the engine that has transformed civilization and has made fairy tales and miracles come true in less than half a century.

GAS ENGINE. We cannot say that the automobile, the airplane, the dirigible balloon, and the submarine could not have existed at all without the gas engine. But it is certain that they would not have been developed so rapidly, so efficiently, and so economically. The steam engine requires a heavy boiler, a fire, and a large supply of fuel. The electric motor must get its electricity from a wire connected to a stationary plant or from a storage battery which is not only heavy but quickly exhausted. We may be sure that, with only steam and electricity, flying at least would not be a practical affair today.

The gas engine is compact, light, and capable of very high speed. It is economical, simple in construction, and easy to operate. In many parts of the West you will come upon reservoirs, for irrigation or for watering cattle, which are fed by gas engine pumps. A man visits them perhaps once a day to give them oil or gasoline, and the rest of the time they chug away in the wilderness until some worn part snaps under the long strain. And then almost any good blacksmith can mend them and set them to work again.

The uses to which the gas engine is put on the farm —where it has largely taken the place of the windmill —and in the shop are almost innumerable. In construction work it performs many of the tasks formerly assigned to the "donkey" steam engine, such as cement mixing, running elevators and derricks, etc. In many places where natural gas or other motor fuel is cheap, big gas engines are used to generate electricity for public use. In all parts of the world— in the burning deserts, on far-away coral islands, in the arctic regions, in tropical forests—you will find the gas engine helping to do man's work.

Although gasoline is the most commonly used fuel for such engines, any substance capable of forming an inflammable vapor or gas under ordinary conditions may serve the purpose. Illuminating gas, blast-furnace gas, kerosene, alcohol, crude petroleum, acetylene, and scores of other substances can be employed if suitable appliances are used. The principle in each case is, as we shall see, exactly the same, and depends upon the explosive or expansive powers of such gases or vapors when they are mixed with air and set on fire.

Because gas engines depend for their power upon the pressure created by the gases burning within the motor itself, and not upon boilers or other external generators of pressure, they are called "internal combustion" engines. Their early development was so gradual and so interwoven with other inventions that no one man is given the credit for being the actual discoverer of this type of power machine.

Steps in its Discovery

The first steps in this direction seem to have been taken late in the 17th century, when certain scientists experimented with "explosion" engines operated by gunpowder, without practical results. In 1791 an Englishman named John Barber took out a patent on a turbine run by illuminating gas. In 1794 Robert Street used the explosions of turpentine vapor to drive a piston, and many others followed. But it was not until 1860 that Etienne Lenoir, a Frenchman, invented a gas engine which came into commercial use. The credit for devising the gas engine as we know it today rests, however, with Dr. Nicholas A. Otto of Cologne, who worked out in 1878 the "four-stroke cycle" system found in most modern motors.

In its simplest form the gas engine consists of a cylinder open at one end, a piston with a long head to keep it straight inside the cylinder, a rod jointed to the piston and connecting it with a crank on the power shaft, and a heavy fly-wheel to help keep the shaft revolving once it has started. At the top of the cylinder, valves are arranged to let in the gas mixture at the proper time and to let out the burned gases after the explosion. Here also is the electric-spark device, which explodes the mixture inside the cylinder.

How a Four-Cycle Engine Works

Here is what happens when a one-cylinder Otto engine is running with illuminating gas: The piston is drawn down, opening the intake valve and sucking the gas into the cylinder. This is the first stroke. As the piston starts upward on the second stroke, the intake valve is closed, and the gas that has been sucked in is compressed into the top of the cylinder. As the piston reaches the top of its stroke the electric spark is set off, exploding the gas and forcing the piston violently downward on the third stroke. As it comes up on the fourth stroke, the exhaust valve opens, and the piston forces out the burned gas. The next stroke sucks in fresh gas again, and the whole process is repeated over and over.

As may be seen, there is only one explosion to every four strokes of the piston or every two revolutions of the crank shaft. The force of this explosion is taken up by the fly-wheel whose impetus keeps the engine moving until the next explosion. In two-cylinder engines the cylinders are timed so that one of them explodes at each revolution, giving a more continuous flow of power. If there are four cylinders, one of them explodes at each half revolution, and so on for six, eight and twelve cylinders. The cranks for the separate cylinders are, of course, arranged on the shaft to conform with the time of the explosions.

Geared to the main shaft of the engine are other shafts, usually two in number, which operate the opening and closing of the intake and exhaust valves. This is accomplished by means of "cams" or metal projections from these shafts. As the shafts revolve, the cams strike the valve rods, raise them, hold them open the required length of time, then drop them again. Strong springs help to hold the valves tightly closed.

The cam which times the electric spark in each cylinder is also situated on one of the cam shafts. This spark is generated by an electric circuit called the ignition system, operated by a set of batteries or a magneto. One wire of the circuit is "grounded" on the metal of the engine, the other leads to a spark plug screwed in the top of the cylinder. This spark plug, usually made with a porcelain core and a metal jacket, terminates in two metal points, about one-thirty-second of an inch apart, inside the cylinder. One of the points comes down through the insulated center of the plug; the other projects from the metal jacket and thus brings the "grounded" current from the metal of the engine to the sparking point. At the proper moment the spark leaps the gap and ignites the gas mixture compressed in the cylinder.

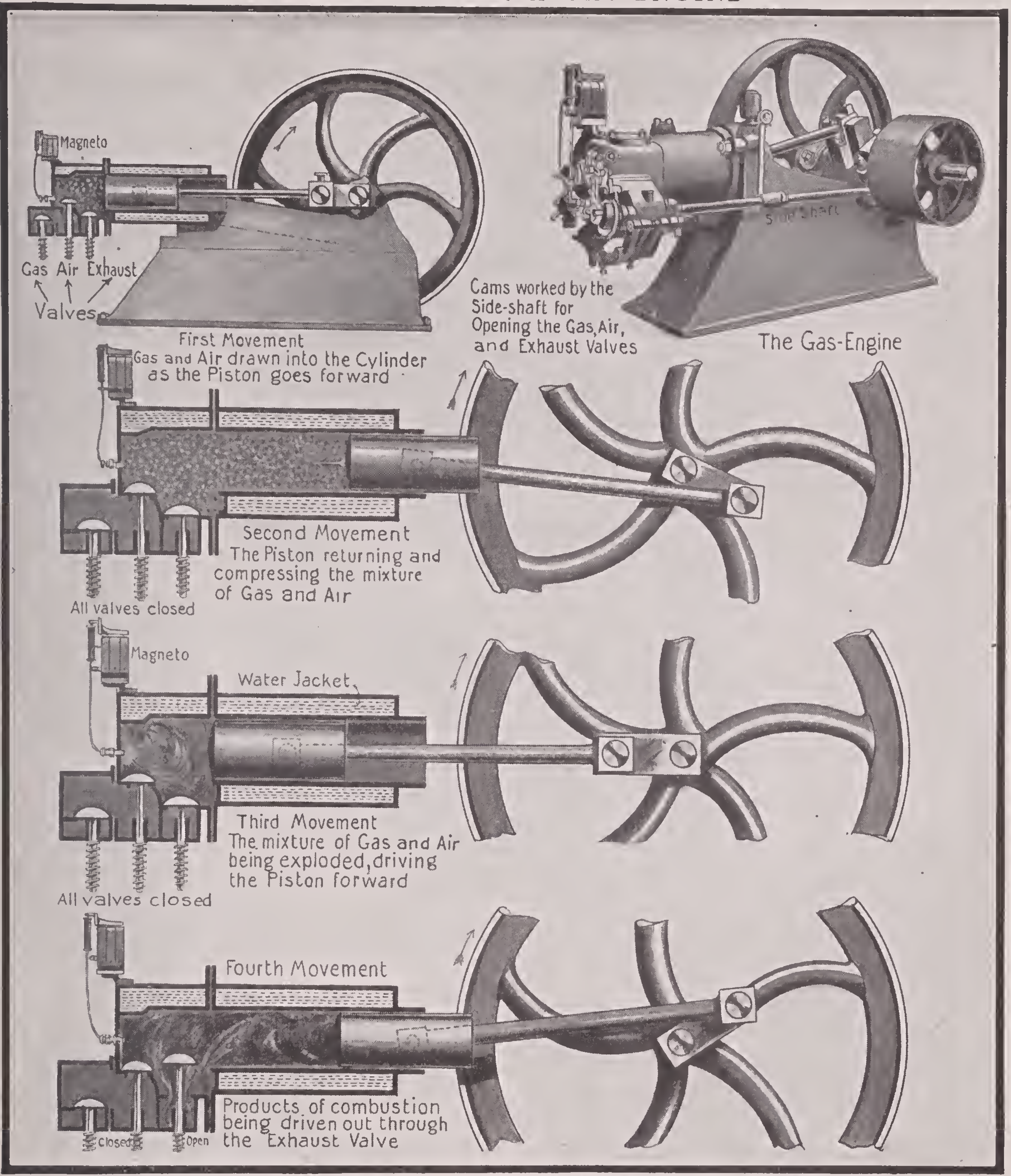
The crank shaft, the cam shafts, etc., are usually inclosed in a covering called the crank case. The bottom of the crank case is filled with oil, and as the piston rod splashes into this oil at every revolution, the interior of the engine is lubricated.

The Lungs of the Engine

So far, we have seen all the essential parts of an engine designed to run on ready-made gas. But when gasoline or any other liquid fuel is used, the Otto type of engine has to have an attachment for turning this liquid into a gas or vapor and mixing it with air so it will explode. This attachment is known as the carbureter, and may be called the "lungs" of the gas engine. Acting under the suction of the piston, air is drawn at tremendous speed through a narrow passageway in the carbureter. In this passageway is a needle valve, which is kept filled with gasoline by a float device. As the air rushes past the valve, it draws out the fuel in the form of a fine spray or vapor, which mixes with the air and is thus carried into the cylinder.

The exhaust of a gas engine is usually carried off through a large pipe terminating in a muffler, which deadens the sharp sound made by the escaping gases.

LOOKING INSIDE A GAS ENGINE


Magneto
Gas Air Exhaust
Valves
Side Shaft
Cams worked by the Side-shaft for Opening the Gas, Air, and Exhaust Valves
The Gas-Engine
First Movement
Gas and Air drawn into the Cylinder as the Piston goes forward
Second Movement
The Piston returning and compressing the mixture of Gas and Air
All valves closed
Magneto
Water Jacket
Third Movement
The mixture of Gas and Air being exploded, driving the Piston forward
All valves closed
Fourth Movement
Products of combustion being driven out through the Exhaust Valve
Closed
Open

Here you see a "four-cycle" Otto engine of the kind described in the text, except that it is of the "horizontal" instead of the "vertical" type—the cylinder lying on its side, so to speak. Notice how there is only one explosion for four strokes of the piston. At the top, the piston is commencing to move out under the impulse of the whirling fly-wheel, sucking in a fresh supply of fuel; on the second movement, it is coming back to compress the gas mixture; the third movement is caused by the explosion, which forces out the piston and gives the fly-wheel a new impulse; and, finally, at the bottom you see the piston about to return and force out the burned gases. In the first movement, the air and gas valves are open; in the next two, all valves are closed; and in the last, the exhaust valve alone is open.

The enormous amount of heat generated by the explosions inside the cylinder makes some cooling device necessary to prevent damage to the metal. Some small motors are air-cooled, having exterior flanges to provide as large a radiating surface as possible. But the great majority of gas engines are water-cooled, and for this purpose a metal jacket surrounds the cylinder proper, leaving an open space through which water circulates constantly. In stationary engines a steady stream of fresh water may be used, but in motor vehicles the water is usually pumped through a radiator, which consists of a large number of small tubes, exposing as much cooling surface as possible to the air.

Two-Cycle Engines

The so-called "two-cycle" engine, often used in motor boats and elsewhere, differs from the "four-cycle" in that it has an explosion for every two strokes of the piston, in other words, for every single revolution of the crank shaft. This is accomplished by a system of ports or openings near the base of the cylinder, which are uncovered as the piston reaches the bottom of its stroke. In the brief instant before the piston starts up again, the exhausted gases rush out through one of the ports and the fresh gas mixture, which has been compressed in the air-tight crank case, rushes in through the other. Then the upward stroke not only compresses the fresh mixture, but draws a new supply into the crank case. Then the explosion at the top of the stroke starts a new "cycle."

The Diesel engines, which became famous during the World War of 1914–18 because of their use on German submarines, differ somewhat in principle from the Otto engines. The heat created by the tremendous compression of air in their cylinders enables them to dispense with carbureters and ignition systems. Any fuel oil, even heavy petroleum or tar oil, can be used in these engines, because it is vaporized by the high temperature as soon as it is injected into the cylinders. Diesel engines are sometimes called combustion engines to distinguish them from the explosion type.

An almost endless variety of models of gasoline engines have been developed to meet various requirements, from the steady, heavy stationary type to the light, swift, powerful airplane motors. Famous among these is the Liberty Motor, designed for the United States air service during the World War, which developed enormous power for its weight (*see* Airplane). The gyro or revolving motor of the Gnôme type is perhaps the strangest gas engine ever built. Its crank shaft is fixed and its cylinders, arranged like the spokes of a wheel, drive themselves around the crank shaft, the power shaft being attached to the rapidly whirling cylinders. (*See* Airplane; Automobile; Submarine.)

The INVISIBLE FUEL *that* COOKS *Our Meals*

How William Murdock Took a Tea Kettle Full of Coal, a Thimble, and a Little Iron Pipe, and Gave the World a New Source of Light and Heat

Gas, Illuminating. A Scotch engineer named William Murdock about 1792 began the experiments which resulted in the application of coal gas to lighting purposes. He heated coal in a kettle and by means of an iron tube carried the resulting yellow gas to a tank. When he had collected enough gas he fitted over the end of the tube a silver thimble, in which he had bored a small hole. Lighting the gas that escaped through the hole in the thimble, he found he had a good light to read by. He had a gas storage tank, a gas pipe, and a gas jet—a complete gas plant on a small scale.

You can make gas just as William Murdock did. Fill a clay pipe with coal dust. Cover the top with modeling clay or stiff mud. Then set the bowl of the pipe over a flame to get very hot. In a few minutes a yellowish smoke will come through the stem. Touch a match to it, and it will burn, but not very clearly, for it is full of impurities. In gas plants these impurities are taken out to make a colorless, smokeless gas and a clear flame.

By 1802 Murdock had succeeded in producing gas in sufficiently large quantities for lighting a foundry, and five years later his discovery was applied to the lighting of streets in London. American scientists who heard of Murdock's achievement followed his example. Gas was used on a small scale for street lighting in Newport, R.I., in 1806, and in 1817 Baltimore installed a complete system of street lighting. Today coal gas is used to light our houses and streets, to cook our meals, and to furnish fuel and power for industries.

What a Big Gas Works is Like

In the manufacture of gas great ovens of brick, called retorts, are filled with from 250 to 350 pounds of coal; a large gas works may have a hundred furnaces or more, each heating from five to ten of these retorts. The retorts are tightly closed, and the coal is roasted, producing coke (*see* Coke) and gas. This coal gas is a mixture of various substances, chiefly hydrogen, carbon monoxide, marsh gas (methane), and other hydrocarbons which burn readily. Nitrogen and carbon dioxide, which are incombustible, are also present, and the gas contains many impurities, such as ammonia, tar, sulphur compounds, and water vapor. To rid it of these, the gas is passed through water, where it loses some of its tar and ammonia; it is then condensed, and passed through the "scrubber" to remove more tar and ammonia. Formerly the tar was not used, but today it is a valuable by-product (*see* Coal-Tar Products). Finally the gas passes through layers of lime or oxide of iron to remove the sulphur, after which it goes into huge storage tanks until it is used. These tanks are great iron cylinders, closed at the top and open at the bottom, resting in cisterns of water. They rise and fall according to the volume of the gas, thus keeping a constant pressure which forces the gas out through the mains.

The old-fashioned flat tip burner was for many years the only method of using gas for lighting. Two discoveries revolutionized lighting methods and enabled the production of a much better light with the use of less gas. One of these was the invention of the Bunsen burner, which mixes the gas with the air and thus produces complete combustion and much greater heat, with an almost colorless flame. The other was the invention of the incandescent mantle, in 1886, by Dr. Carl Auer von Welsbach of Vienna. In the Welsbach system the light comes from a "mantle" heated white-hot in the Bunsen burner. The materials for these mantles come from opposite sides of the earth. Natives of India grow the China grass, whose fiber is needed for weaving the mantles, while in far-away Brazil rare earths are mined containing the chemical elements thorium and cerium, with which the mantles are saturated. After the vegetable fiber of the China grass has been burned away, a mineral "skeleton" of the fabric is left, which glows with a bright white light. The illuminating power of gas is increased about three times by the use of the Welsbach mantle.

THE FIRST HOUSE LIGHTED BY GAS

Imagine the astonishment of passers-by when they saw the windows of William Murdock's house in Redruth, England, gleaming for the first time with a brilliance that no candles or lamps could hope to attain! He made the gas at home and the next year (1802) illuminated a foundry with the new fuel.

But, with the advent of electric lighting, the use of gas for illumination has become less important than its use as fuel. The gas-range has largely replaced the coal-range in the homes of city dwellers, its chief advantages being the ease with which the heat can be turned on and off, and its general cleanliness.

Gas is distributed from the manufacturing plant through "main" pipes, sometimes as much as six feet in diameter. From these, service pipes lead to the individual consumers, where meters measure the amount used (*see* Meters). The pressure in the service pipes varies in different places from about one to two ounces per square inch. In places where the population is scattered over wide areas, the use of high pressure gas (from 10 to 20 pounds per square inch) has been largely advocated in recent years.

Many cities now use a gas called "water gas," a mixture containing chiefly hydrogen and carbon monoxide, made by passing steam through red-hot coke or hard coal. The gas thus produced burns with a very hot blue flame, but it is extremely poisonous because of the high percentage of carbon monoxide it contains. To fit it for use as an illuminating gas it is "carburetted," that is, mixed with gases which burn with a luminous flame, such as ethylene and acetylene. Another gas, highly useful in industrial processes, is "producer" gas. The best quality is made by passing air through white-hot coke, although coal and even peat may be used. Blast-furnace gas, generated in the operation of blast furnaces, is another fuel of this type.

Most of the railroad cars of the United States are lighted by compressed gas made from petroleum, in what is called the *Pintsch system.* Acetylene gas is widely used where there are no central gas works (*see* Acetylene). Gasoline is also used for illumination, by vaporizing it in a current of air in an incandescent mantle.

GAS, NATURAL. For a long time natural gas was regarded merely as a curiosity. In China, Persia, and British India, where it issued from crevices in rocks, it was kept burning and worshiped by the natives as a fire god. Near Baku, on the Caspian Sea—one of the world's greatest oil centers—are the ruins of an old temple built on the site of one of these fiery jets.

The United States apparently has the greatest wealth of natural gas. "Burning springs" were known in this country as early as 1775, and its first discovery by drilling was made early in the 19th century. Workmen boring a salt well in Ohio struck a subterranean gas pocket, and when it flamed forth they fled from the spot crying, "We have drilled through to hell!"

In 1821 natural gas was used for lighting in Fredonia, N.Y., but it was not until 1872 that it began to be collected and piped on a commercial scale. The beginning was made in Titusville, Pa., in the heart of the Pennsylvania oil regions, and since that time the natural gas industry has had a tremendous growth. The total amount used each year is now valued at about $120,000,000—a sum four times greater than the annual gold production in the United States. Natural gas has been a boon to many specialized industries, particularly in fine smelting and in the manufacture of gears, where a hot clean flame is needed. It is the cheapest fuel known.

In view of its present value, we now realize that fortunes were wasted in the early days, when the gas, shooting up in great flaming geysers, was allowed to burn on unheeded. Natural gas is almost always found in the neighborhood of oil wells, and in one oilfield in Oklahoma 3,000,000 cubic feet of gas worth $75,000 escaped every day for a year, while only $25,000 worth of oil was being collected. This early waste has resulted in exhausting many of the gas wells, and many cities which for a time used this natural fuel for heat and light have seen their supplies dwindle to nothing.

Wastage has virtually stopped today, and many thrilling stories are told of how "roarers" 100 feet high have been smothered, confined, and tamed to use. There are now nearly 3,000,000 consumers of natural gas in the United States, and the number is gradually increasing, as fresh fields are discovered.

The chief producing states are West Virginia, Pennsylvania, Oklahoma, Ohio, Louisiana, Kansas, California, Texas, and New York. In Canada the principal fields are in Ontario and Alberta. Natural gas has also been found in Australia, Rumania, Russia, India, China, and Japan.

Natural gas occurs pocketed in rock formations of various ages. It is not a chemical compound, but a mixture of several compounds—combustible gases and vapors, chiefly methane. It is generally believed that it is produced by the decay of organic matter—especially vegetation deposited in by-gone geological ages. The reservoir containing the gas is a porous rock, such as a coarse-grained sandstone or limestone; it usually has as a cover a heavy shale, which keeps out water and air and keeps the gas in.

The wells vary in depth from 250 feet to more than 7,000 feet and in diameter from 2 to 8 inches. The open flow varies from 500 to 35,000,000 cubic feet a day. A volume of 1,000,000 cubic feet per day is considered a profitable commercial well.

GAS WARFARE. The employment of poisonous and asphyxiating gases became one of the most terrible of modern methods of warfare after the Germans had introduced it at Ypres in 1915, in direct violation of a regulation of the Hague Convention (*see* Hague Peace Conferences). The gases used include the familiar iritating chlorine; diphenylchloro-arsine, a "sneeze gas" or sternutator; superpalite, a tear-compelling gas or lacrimator; phosgene, a gas so deadly that one part in 10,000 of air may be fatal; and many others acting in various ways, some attacking the lungs and causing asphyxiation, some paralyzing the nerves, some producing nausea and vomiting and thus compelling the soldier to remove his mask and expose himself to deadlier gases, and others—the deadliest of all—attacking, consuming, and burning all exposed tissues. To the last class belong the so-called "mustard gas" (dichlor-diethyl-sulphide), and ethyl dichloro-arsine, both of which are not gases at ordinary temperatures, but volatile liquids spreading corrosive fumes which linger in soil and clothing for days. Soldiers who had worn gas masks continuously were overpowered on removing their masks 12 hours after a mustard gas attack.

These poison gases were diffused by two chief methods, the gas cloud and the gas shell attack. For the former, chlorine and phosgene, which is composed of chlorine and carbon monoxide, were chiefly used. These gases, liquefied under heavy pressure and placed in large metal cylinders, were liberated when the wind blew toward the enemy. This method has the disadvantage that, if the wind changes, the gas cloud may be rolled back on the attackers. Gas shells are like ordinary explosive shells, except that they are almost filled with liquefied gas, and contain just enough explosive to burst the shell.

For protection against gas attacks, all soldiers in front line trenches were equipped with gas masks. These were of two chief types, either a bag worn over the head or a box slung on the chest, with nose-piece and breathing tube attached. They contained either neutralizing chemicals or charcoal, which because of its ability to absorb many times its own volume of gas was most generally used. Because charcoal made from nutshells and fruit pits was found to be the best for the purpose, large quantities of these were collected by boys and girls all over the United States.

GASOLINE. A colorless inflammable liquid produced by distilling crude petroleum. In Europe the accepted name for it is petrol. Until the discovery of the immense power that can be developed from gasoline, it was considered a waste product in the refining of petroleum to obtain kerosene. It has now become of great commercial importance as the most convenient source of vapor for internal combustion engines of the types used in automobiles, airplanes, tractors, certain stationary engines, etc. Gasoline is more volatile than kerosene. (*See* Petroleum.)

GATES, HORATIO (1728–1806). To General Horatio Gates belongs the honor of having commanded the victorious American troops in one of the world's decisive battles, the battle of Saratoga in the Revolutionary War, and yet before the close of the war he had retired from the army in disgrace. This fall from the position of a successful commander and a popular idol to that of a military failure and a despised intriguer is explained in a large degree by Gates' exaggerated ambition, a trait which had manifested itself in his early career.

As a young British officer he had served with General Braddock at the time of that officer's disastrous defeat by the French in 1755 (*see* French and Indian War). Impressed by the visions of prosperity he had seen and by the easy successes to be won in the New World, he had settled in Virginia at the close of the French and Indian War in 1763.

At the outbreak of the War for Independence he was made an adjutant-general of the Colonial army by the American Congress, and the next year was put in command of the army which was retreating from Canada. As commander of the army in the North, Gates received the surrender of Burgoyne at Saratoga on Oct. 17, 1777, and for a time was hailed as a great general. Many people have thought that he did little to gain the decisive victory, and that most of the credit belongs to General Schuyler whom Gates superseded. Soon he became the center of a plot, known as the "Conway Cabal," to take the supreme command from Washington and give it to him. The plot failed. In 1780 Gates was placed in command in the South, but at the battle of Camden, S. C., his troops were completely defeated by Cornwallis. When nightfall came, Gates was found miles away from the scene of battle. This ended his military career. He retired in disgrace to his Virginian estate, and two years later after freeing his slaves he removed to New York, where he remained until his death.

GELATIN. When you eat the quivering variously colored dessert so often served with cream in a jelly-like mound, you are making an intimate acquaintance with one of the many uses of gelatin—its use as a foodstuff, in puddings, jellies, soups, etc.

Gelatin is a hard, yellowish, semi-transparent substance obtained chiefly from animal tissues, especially bones, horns, and hoofs. There are a number of processes for producing it, and a number of varieties, ranging from glue to table desserts. When bones are soaked in weak acid, certain parts dissolve and leave behind the bone cartilage; and when this is boiled it dissolves and forms gelatin. Vegetable gelatin is manufactured from seaweed and Irish moss.

In its crude condition gelatin is cut into slices, dried, and sold as glue. Sometimes gelatin is purified by dissolving in hot water and adding alcohol. Purified with sulphurous acid it is used for making the tough, whitish, semi-transparent substance called "isinglass" so valuable in refining liquors and stiffening food. The best isinglass and edible gelatin is obtained from the air bladder of fish. It was formerly obtained solely from the sturgeon of Russia, but it is now procured also from the cod and other American fish. (The name isinglass is often incorrectly applied to the mineral mica, which splits into thin sheets closely resembling the gelatin isinglass.)

Gelatin is one of the ingredients of printing-press rollers. It is used as a coating or capsule for pills, and is employed in dyeing and tanning, in making paper, waterproofing material, India inks, artificial leather, and artificial silks. Gelatin also forms the base in which are imbedded the sensitive chemicals used in coating photographic plates, films, and papers.

GLITTERING PEBBLES *More Precious than Gold*

GEMS. In the India of a few centuries ago, princes filled their treasure chambers with precious stones almost by the bucketful. Many of these priceless jewels—such as the pearl scarf of the Maharaja of Indore, worth perhaps $3,300,000—have descended through dynasties of Hindu rajas and Mogul emperors to the native princes of today.

BIRTHDAY STONES

The following are the birthday stones and their supposed significance:

January	Garnet	Constancy
February	Amethyst	Sincerity
March	Bloodstone	Courage
April	Diamond	Innocence
May	Emerald	Success in love
June	Agate	Health and long life
July	Carnelian	Content
August	Sardonyx	Conjugal felicity
September	Chrysolite	Antidote to madness
October	Opal	Hope
November	Topaz	Fidelity
December	Turquoise	Prosperity

Although India is famous beyond all other countries for its superb collections, gems and precious stones have been valued highly in all lands and ages. They are ranked according to color, luster, hardness, durability, and rarity. Diamonds, rubies, sapphires, emeralds, topaz, garnets, and chrysoberyl rank first in value. In the second class are turquoise, tourmaline, opal, agate, jasper, and onyx; in the third are the less precious but still ornamental stones such as lapis lazuli and moonstone. Other jewelry substances are the costly pearls and the less valuable coral, derived from animals; and amber, a fossil resin of vegetable origin.

The sparkling diamond, the "king of gems," which is pure crystallized carbon, is the hardest of the precious stones (*see* Diamond). It has been estimated that there are less than 47,000,000 carats of cut and polished diamonds in existence, and that these altogether would weigh only $10\frac{1}{2}$ tons, and could be packed into a large clothes closet!

Rubies and sapphires rank next for hardness. Both are transparent varieties of the mineral corundum, which is aluminum oxide. Emery is an impure form of the same mineral (*see* Emery). The best rubies—which are usually a pure carmine red—come from Burma, Siam, and Ceylon. Pink, purple, and violet rubies are also found, but those most valued are of the peculiar tint called "pigeon's blood." Large rubies are very rare, and specimens of three or four carats are worth from two to five times as much as diamonds of the same size. Although they are seldom more than eight or ten carats in weight, Gustavus III of Sweden is said to have given one as big as a pigeon's egg to Catherine of Russia. Two of the largest rubies known, belonging to the ruler of Bishnupur in India, weighed $50\frac{3}{4}$ and $17\frac{1}{2}$ carats, respectively. The so-called rubies found in the western United States, South

Africa, and Australia are a fine variety of garnet.

The pretty bright blue sapphires, which are found mainly in Siam, Burma, Ceylon, and Cashmere, are valued chiefly for quality rather than size. Specimens of great size have been found, one weighing as much as 951 carats. Montana yields a considerable number of sapphires, nearly all of which are used for bearings in watches and delicate instruments. The beautiful deep green emerald is the same material (a silicate of aluminum and glucinum) as beryl, which varies from blue to light green and yellow. Flawless emeralds are rarely found and rank with the diamond in value. The modern supply comes for the most part from Colombia. The ancient supply came chiefly from Upper Egypt, where mines are still worked. Some specimens are of great size, one found in the Ural Mountains weighing 6¾ pounds.

The trade in gems, cut and uncut, both mounted and unmounted, is enormous. In New York City alone there are said to be more than $250,000,000 worth of cut gems, while the total value of precious stones in France is about a billion dollars. The United States normally produces one-third of a million dollars' worth of precious stones, chiefly sapphire, quartz, tourmaline, and turquoise, and found mainly in Montana, Nevada, California, Colorado, Maine, and Arizona.

Rubies and sapphires are now manufactured in the electric furnace. These synthetic stones, as they are called, have nearly all the qualities of the natural stones. Even experts find it all but impossible to distinguish the artificial specimens from the natural. Millions of carats of rubies and sapphires have been manufactured, chiefly in France and Switzerland, where electric current is cheap. The Orient is a large buyer of these stones. Real diamonds, too, have been made in the electric furnace, but of such microscopic size and at such great cost as to make the process commercially impracticable.

IN A RUBY MANUFACTURING PLANT

A prosaic looking outfit, isn't it? So far as appearances go, this might be behind the scenes at a soda fountain, but what is really taking place is that certain substances containing aluminum and chromium are being subjected to intense heat in little electric furnaces, after which they crystallize into artificial rubies. They are of exactly the same composition as real rubies. Think of it! Those beautiful gems are composed largely of aluminum, the same material of which kitchenware is made, while it is the chromium, another common metal, which gives them their brilliant red color.

Imitation gems, as distinguished from synthetic gems, have been made since the earliest times. The usual basis is a kind of hard, clear, and brilliant glass called "paste" or "strass," which has a high proportion of oxide of lead in it. Imitation sapphires are made 1,000 parts paste and 25 parts of oxide of cobalt, while imitation garnets are produced by mixing 1,000 parts paste and a variable quantity of purple of Cassius. Imitation diamonds are made of pure paste cut into brilliants and roses. Immense quantities of these paste gems are made in large factories in France and elsewhere, to be used in cheap jewelry. They can be readily distinguished from real stones by their softness and lack of depth and brilliancy.

Gem cutting and engraving—the lapidary's art—has been practiced from very remote times (*see* Cameo). Great numbers of precious and semi-precious stones have been found in Mesopotamia cut into cylindrical form and bearing engraved figures. When rolled over the soft clay of writing tablets, these cylinders left the design in relief to serve as a personal seal. This art had been developed to a high degree of perfection by the ancient Sumerians at least as early as 3000 B.C. Seals engraved with the sacred beetle, called scarabs, were in use in Egypt by the same time.

Of the many other precious and semi-precious stones, pearls are the most prized. These beautiful gems of white, pink, black, etc., with their play of delicate tints, are secretions of the lining membranes of various kinds of shellfish. The pearls of commerce come chiefly from the pearl oyster found mostly in the Persian Gulf and on the west coast of Mexico (*see* Pearls).

Topaz is a translucent gem of a sherry yellow color (although sometimes pale blue, green, brown, or white) the finest of which come from Brazil or Ceylon. *Garnet*, usually red but sometimes brown, yellow, green, or black, is found particularly in crystalline rocks of Bohemia, Ceylon, Peru, and Brazil. *Chrysoberyl* is a bright very hard rare stone of yellow, brown, and light green. *Turquoise*, a hard greenish-blue stone (a phosphate of alumina colored by copper), is found mostly in Persia. *Opals* are bluish, black, or yellowish-white stones composed mostly of silica and water, with a beautiful play of brilliant colors. The finest come from Hungary. Common opals are white, yellow, green, red, and brown without any play of colors. *Jet*, a black polished mineral (a variety of lignite), is often used for mourning jewelry. *Lapis lazuli* is a beautiful azure-colored mineral much used in ornamental and mozaic work, and now manufactured on a large scale at a low cost. *Jade* is a hard green stone much prized in oriental countries for making ornaments. *Amethyst*, a purple variety of rock crystal or quartz, is found in Brazil, Ceylon, and elsewhere. *Agate* is a kind of *chalcedony* or uncrystallized quartz with bands of variegated colors or the colors arranged in a cloudy or mosslike formation. Gray, brown, red, black, and white are the most common colors. They are found especially in Germany, Scotland, South America, and many parts of the United States and Canada. Especially prized is the black and white banded agate, called *onyx*, and the red and white known as *sardonyx*, from which cameos are cut. *Tourmaline* is found in granite, gneiss, and mica schist. It occurs in many colors, and there are also colorless varieties. Sometimes two colors blend into each other in the same stone, or there will be one color inside and another outside.

JUST OUT OF THE FIRE

Artificial rubies are built up in the furnace by allowing the melted chromium and aluminum, as formed, to drip on a matrix, thus building up the gem as the drip of water builds up an icicle on the edge of a roof.

GENEVA, SWITZERLAND. "A bird's nest of a place; the most lovely spot and the most notable, without any possible dispute, of the European universe." This is what the great art critic Ruskin said of Geneva. The town nestles in a cup of the Alps at the lower end of famous Lake Geneva (*Lac Leman*), whence the Rhone River issues as clear and blue and shimmering as a butterfly's wing. Sweeping under its white bridges, the river forms two islands, one of which is called the island of Jean-Jacques Rousseau, after the great revolutionary writer, who was one of Geneva's many famous sons. The town is as clean and shining as the river, with broad promenades by the lake and streets of handsome white stone houses. And when at sunset the snow-clad peak of Mont Blanc, 40 miles to the southeast, becomes visible among its lesser sisters in delicate rose and white and lavender, the spectacle is one of almost unearthly beauty.

Lying nearly in the center of Europe, and one of the gateways to Switzerland—"the world's playground"—Geneva has long been a favored resort for travelers. Its beauty, its ancient traditions of cul-

BEAUTIFUL LAKE GENEVA AND ITS LOVELY CITY

We are looking across the southwestern end of the crescent-shaped Lake Geneva from one of the public gardens of the city of Geneva. On the opposite bank is the newer part of the town, where are situated the many hotels patronized by tourists. Back of the city rise great barren rocks and beyond them glitter the eternal snows of the Mont Blanc chain. It is at this point that the Rhone River runs out of the lake.

ture, its fine old university, have induced many citizens of other lands to make it their home; and its jealous defense of the right of political asylum has made it a harbor for revolutionists, radicals, and political refugees. During the World War of 1914–18 it was a veritable hotbed of plots and counterplots by emissaries of the warring countries. Since the neutrality of Switzerland is guaranteed by international agreement, Geneva has been the scene of several important diplomatic meetings. These include the arbitration of the *Alabama* claims between the United States and Great Britain, and the international conferences of 1863 and 1868, which resulted in the organization of the International Red Cross. At the close of the World War it was chosen as the capital of the new League of Nations.

Geneva is French in language and in customs, for it is almost completely surrounded by France, only a narrow strip connecting it with the rest of Switzerland. Its principal industries are the manufacture of watches, scientific instruments, and jewelry.

In the days of the Roman Empire Geneva was already a city. At the close of the Middle Ages the citizens freed themselves from the feudal control alike of their bishop and of the neighboring house of Savoy, and established a self-governing republic. John Calvin, the great religious reformer, made Geneva in the latter half of the 16th century the leading center of Protestantism. The most celebrated event in the city's history was the repulse of a surprise attack on the city in 1602 by the house of Savoy, its hereditary enemy. In memory of the event the Genevese still hold a festival every year. Napoleon Bonaparte annexed Geneva to France in 1798, but with his fall in 1815 the city regained its freedom. Since that date it has been a part of Switzerland, with whose confederated cantons Geneva had been politically allied for nearly three centuries before the French conquest. Population, about 140,000.

Beautiful Lake Geneva, 45 miles long, is the largest lake in Switzerland. At the other end from the city of Geneva, near Lausanne, is the Castle of Chillon, made famous by Byron's poem, 'The Prisoner of Chillon'.

GEN'OA, ITALY. Since early historical times Genoa "the Superb," rising from the Gulf of Genoa in beautiful relief against the sharp slopes of the Apennines, has been one of the most important seaports on the Mediterranean Sea and a gateway to northern Italy. From its great harbor hundreds of noted sea captains have set sail on romantic adventures of conquest and commerce in distant lands, making it a fitting birthplace for its most famous citizen and navigator, Christopher Columbus.

Stretching upward from its magnificent quays and docks which line the 600-acre harbor, the city covers the slopes of the surrounding hills with noble palaces and ancient churches, terraced gardens and orange groves, while against the distant sky are outlined its protecting chain of strong fortifications stretching for 11 miles along the higher peaks.

The prosperity of Genoa in earlier times rested largely upon its commerce with the lands of the Eastern Mediterranean, and through these with India and China. Booty from military expeditions, chiefly against the Moors in Spain, was also an important source of wealth. Today its importance is due to a large export business in silks, olive oil, rice, wine, coral, paper, soap, macaroni, and marble.

After passing through the hands of the Lombards and the Franks, Genoa became an independent city upon the breakup of Charlemagne's empire. It fought a long series of wars with Pisa, its southern neighbor, in which the latter was crushed in 1284. A similar series of wars, due to commercial rivalry with Venice, ended with Genoa's disastrous defeat at Chioggia in 1380. The aristocratic and the democratic factions were in constant turmoil up to the 16th century, when the autocratic rule of the doges began.

The noted Bank of Genoa, founded in the 12th century, presented in the Middle Ages the spectacle of a small group of merchant capitalists who virtually dictated laws and gave orders to the government. This historic wealth is reflected today in an imposing array of fine churches, palaces, schools, libraries, and museums. The city has a flourishing university, founded in 1471. Corsica, the last of the city's foreign possessions, revolted and was taken by France in 1768. Sardinia-Piedmont acquired the city in 1815, and it became a part of the kingdom of Italy with the union of the peninsula under the Piedmontese kings. Population, about 300,000.

GENTIAN (*ğĕn'shŭn*). When the September woodland borders are touched with gold and red and the meadows and thickets, browned by the hot summer sun, are cooled by the autumn breezes, a flower of heavenly blue rises among the bright goldenrod and bursting milkweed, waving and nodding its proud head before the gay world. Long long ago, so it is said, Gentius, king of ancient Illyria, discovered that a medicine could be produced from the root of this lovely plant, and it is in his honor that it is named. In Switzerland, on the green sunlit slopes of the Alps, whole pastures are blue with it.

The Gentian flower, named after an ancient king, unfolds its beautiful blue blossoms in the fields as a sign that Fall has come.

The fringed gentian of North America, which becomes rarer each year owing to thoughtless gathering, has a tiny fringe around the edge of its four pretty petals. We find these bright blue flowers growing from Quebec southward to Georgia and west beyond the Mississippi, blooming from September to November. When the darkness falls they fold their beauty until the smiling sun beckons them out again:

> Then doth thy sweet and quiet eye
> Look through its fringes to the sky,
> Blue—blue—as if that sky let fall
> A flower from its cerulean wall.—*Bryant.*

Another of the more than 300 species is the closed gentian, whose clustered flowers never open. A few rare species are white, yellow, or red, the latter being found in the Andes. In the Catskills of New York a five-flowered gentian of conspicuous yellow is found.

Scientific name of fringed gentian, *Gentiana crinita.* Flowers solitary and stiffly erect at the end of a long stalk; calyx of 4 unequal lobes; corolla, funnel form; 4 stamens inserted in the corolla tube, and 1 pistil with 2 stigmas. Stem from 1 to 3 feet high, leafy and branched. Leaves opposite, acutely tipped on top, gradually broadening to heart-shaped.

Our WIDE, WIDE WORLD—*Its Lands and Peoples*

Vast and Varied Panorama Presented in the Study of Geography—Getting at the Secret of the Growth of Cities—Thrilling Stories Back of the Maps of the World

GEOGRAPHY. On the other side of the earth, in the hot wet island of Borneo, are the savage Dyaks, who live in houses set on piles along the rivers, hunting game with spear and blowgun and planting crops of rice and vegetables. Up in arctic Labrador the sturdy squat Eskimos dwell amid snow and ice, getting their food and clothing from the animals of sea and land. The patient Chinaman, bent with toil, works day and night in his little terraced rice field, up to his knees in water, using his bare feet to pack the mud around the young rice plants and to pluck the weeds. So many are the mouths he has to fill and so tiny his field that the failure of a crop means death to hundreds of thousands.

Along the Nile the Egyptian fellah laboriously lifts the water of the river by long sweeps into the ditches that irrigate his field. On the vast prairies of North America farmers drive great gang plows drawn by six, eight, or ten horses or by mechanical tractors, producing enormous crops of grain to feed the hungry world. On the immense treeless steppes of central Asia, where there are no mild ocean breezes to temper the cold of winter and the extreme heat of summer, the Kirghiz and Mongols wander about pasturing their flocks and herds on the tall grasses. In the sweltering fever-ridden jungles of the Amazon, naked savages, too low in civilization to have learned to plant crops, live on the fruits and nuts of the trees, the fish of the rivers, and the animals they slay; while only a short distance to the west, still near the Equator, the mountain shepherds of Bolivia dwell on the lofty heights of the Andes, where it is so cold only the hardiest crops will grow and men would perish but for the food and clothing they get from their flocks of llamas.

How Geography Helps Tell Men's Fortunes

Why do the peoples of the world differ so widely in the way they live, in dress, appearance, customs, intelligence? The fascinating science of geography tells you. It shows how land and ocean, rivers and mountains, plains and valleys, temperature and wind and rainfall, in large measure control the ways in which men live and the degree of civilization they attain.

Here and there men have come together into great cities, each with an individuality of its own and each crowded with interest to the wide-awake mind. London, Paris, Constantinople, Peking, Cairo, New York, Chicago, Quebec, Bombay, Buenos Aires—every name is a flash of romance and mystery. Why did these great cities spring up at just those spots? Geography tells you. It shows how some, like New York and London, owe their existence chiefly to their excellent harbors. Others, like the manufacturing cities of the Atlantic states, grew up on the edge of the Piedmont plateau—the broken hilly country between the coastal plain and the inland mountains, where the abundance of water-power was favorable to the growth of manufactures. Some, like Chicago and Winnipeg, have come to greatness because they stand at strategic points on great trade routes. Others, like Pittsburgh and Sheffield, have been made by the proximity of great iron and coal deposits.

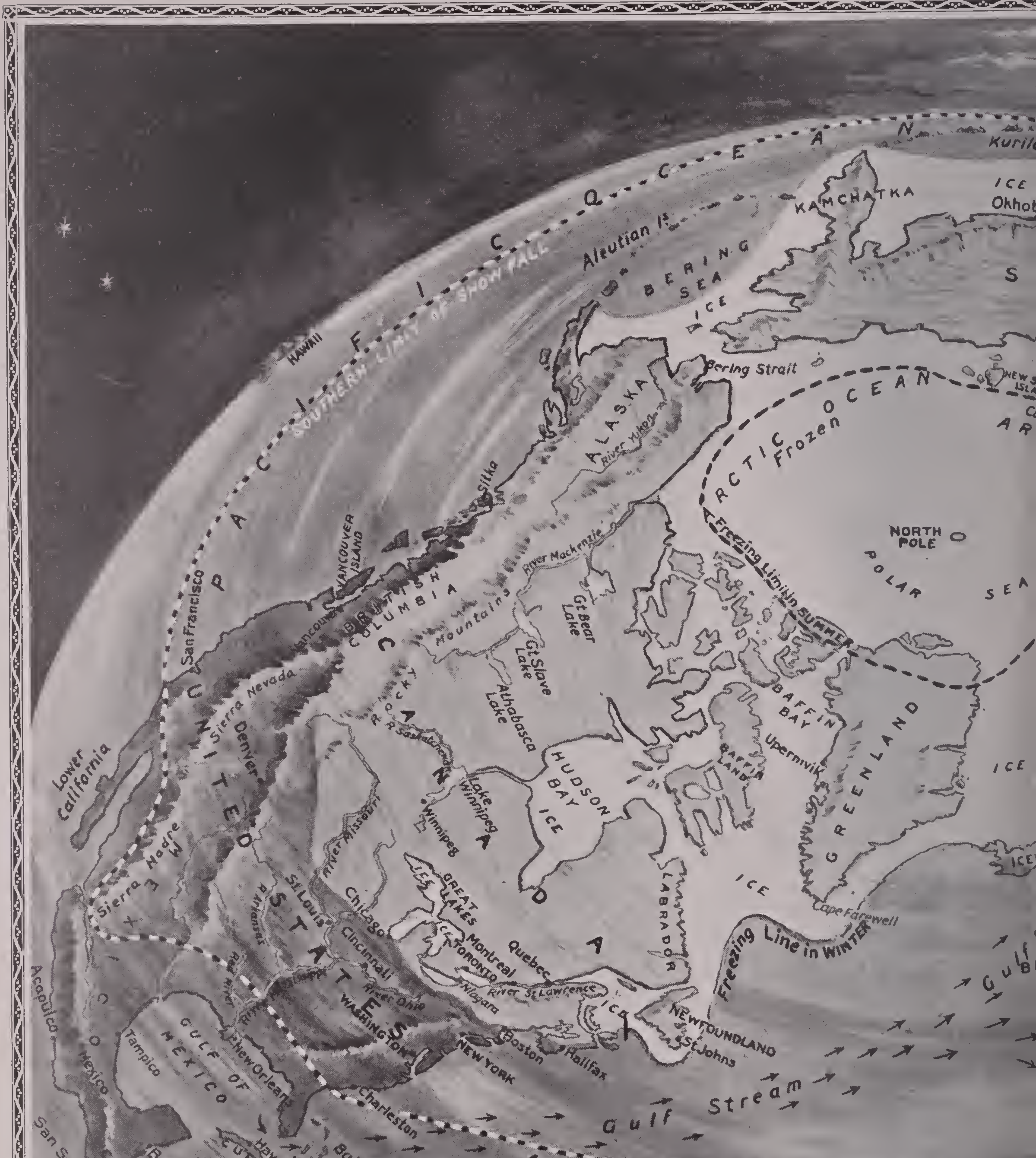
And so one might go on for pages, merely suggesting some of the myriad interesting things the study of geography has to tell us about the earth as the home of man. But this, while the most interesting and important of the aspects of geography, is only a part of the story. As its name shows, geography (from the Greek words meaning "earth" and "to write") is a description of the earth. Its vast subject-matter naturally falls into several main divisions, which are variously classified. The simplest division is into mathematical geography, physical geography, and biogeography, or the geography of living things.

Relation of Geography to the Story of the Stars

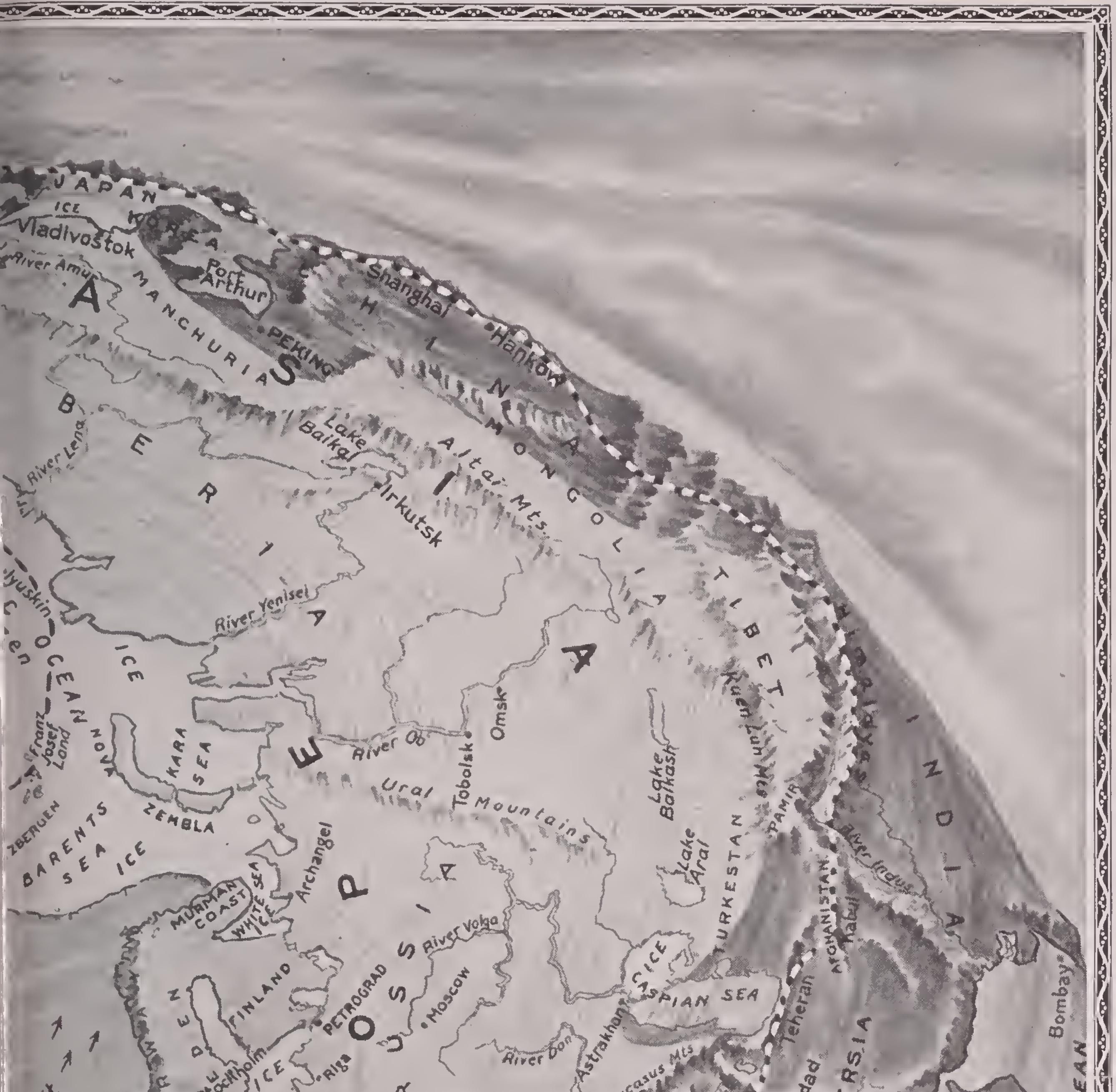
Mathematical geography treats of the form, size, and movements of the earth from the standpoint of mathematics. In considering the movements of the earth and its place in the solar system, it is closely connected with astronomy. And since it also has to do with the measurement of the earth and the various methods of representing its surface on maps, it is related to surveying and cartography or map-making.

Physical geography, which is practically identical with physiography, as the term is commonly used, treats of the physical features of the earth—land, sea, and atmosphere. Geology, oceanology, climatology, and meteorology all contribute to supply the data of this department (*see* Physiography).

THE HUGE STAGE ON WHICH



LIFE'S DRAMA IS PLAYED



Thinking of the Earth as the home of man, and Geography as the science that deals with it as such, what a magnificent subject for investigation and reflection this view of the globe provides us! Here we have the theater on which almost the entire drama of the world's history has been enacted.

Beginning with the cold and barren region in which the Eskimos, the Lapps, and other Arctic peoples have made such difficult progress, and have overcome the obstacles of climate and situation in so many ingenious ways, we pass down through the temperate regions where the civilization of today has reached its highest point. Further down we reach lands with climates so mild and friendly that fewer obstacles were offered to man's progress. Here the oldest civilizations grew up, the civilizations of Egypt, Babylonia, Greece, and Rome.

In imagination we can people this map with the Siberian hunters in their land of snow and ice, with the prosperous farmers busy at their great harvest on the prairies of North America, with the patient Chinamen toiling in their terraced rice fields, with the Egyptian "fellahs" patiently lifting the Nile water with their long sweeps, and with the wandering Mongols driving their flocks and herds over the immense steppes of Central Asia. With this picture before us, we can reflect "how land and ocean, rivers and mountains, plains and valleys, temperature and wind and rainfall control the ways in which men live."

Finally comes the great department which treats of the living things that dwell on the earth, their distribution and life conditions, culminating in the geography of man. Man is the animal that has learned to conquer and control geographical conditions. By great engineering works he modifies the earth's surface to his advantage. He drains and irrigates the land, tunnels through mountains, reclaims land from the sea, and even severs continents by canals. By cultivation and breeding he changes the distribution of animals and even produces new varieties. All other branches of geographical study are subordinate to this crowning department and focus in it. Hence human geography, as it is sometimes called, is further divided into various subdivisions, such as political geography, which deals primarily with the distribution of the human race, and economic or commercial geography, which treats of the manufacture and distribution of the world's products (*see* Commerce; Transportation).

The progress of geographical knowledge has depended largely on the progress of discovery. The Phoenicians were the first people who communicated to other nations a knowledge of distant lands. Their voyages before the time of Homer, through the Euxine, the Mediterranean, and even into the Atlantic, form the first link of the great chain of discovery which, centuries later, was extended by Columbus to the shores of America. Travelers like the Greek historian Herodotus did much for the advancement of geography, as did also the exploring and surveying expeditions of Alexander the Great. At the same time Pytheas, the Massilian navigator, was following the path of discovery in the north, possibly as far as Iceland, and in 276 B.C. Eratosthenes first used parallels of longitude and latitude and made maps on mathematical principles. By this time the old idea of the earth as a flat circular shield surrounded by a rim of water had given place to the belief that the earth is a sphere, revolving with the surrounding atmosphere on one axis. The practical genius of the Romans led them to make a study of the resources of the countries they conquered, which did much for geography. Their greatest work was a survey of the whole empire, including a description and measurement of each province, which was made under Caesar and Augustus. In the 2d century of our era Ptolemy wrote a work on geography, in eight books, which remained the authority for many centuries.

How Men Put New Countries on the Map

The travels of the Venetian, Marco Polo, in the 14th century opened new fields of inquiry, and the close of the next century was marked by the discovery of the American continent. Within 30 years the whole coast of America, from Greenland to Cape Horn, had been explored; the Pacific Ocean had been navigated by Magellan and the world circumnavigated by his ship; the coasts of eastern Africa, Arabia, Persia, and India had been visited; and numerous islands in the Indian Ocean discovered. The attempts to find a northwest passage to India increased the knowledge of the Arctic regions. In the 17th century the Dutch made known to the world the Australian Islands (which the Portuguese had discovered a few years before). Captain Cook in his three voyages completed our knowledge of most of the Pacific lands.

The Great Work of the 19th Century

At the beginning of the 19th century explorers were familiar with the outline of the continents and most of the islands, but four-fifths of the land area was still practically unknown. There was only the scantiest knowledge of central and eastern Asia, and of the interior of the Americas. Africa was still truly the "Dark Continent." Most of the Polar lands were still undiscovered and the existence of the vast Antarctic Continent was derided as an empty fable. By the close of the century, most of these immense gaps in geographical knowledge had been closed by the labors of such heroic explorers as Lewis and Clark, Fremont, Pike, and Selkirk in North America; Parry, Franklin, the two Rosses, McClure, Kane, Nansen, Peary, and a score of others in the Polar regions; Livingstone, Stanley, Burton, Speke, and Schweinfurth in Africa; Younghusband and Sven Hedin in Asia. But it was not until our own century that the veil was torn from the two chief objects of exploration —the North Pole, attained by Peary in 1909, and the South Pole, by Amundsen in 1911 and Scott a month later (*see* Polar Exploration).

The work of making geography is still going on. There are vast tracts, notably in northern Asia, in Africa, in South America, and in northern Canada, of which we have only the scantiest knowledge. In the study of the ocean and the atmosphere too there is still much to be done.

In this making of geography, geographical societies and associations for securing and spreading geographical knowledge have performed an important part. The first of these societies was founded in Paris in 1821. The first society in the United States was the American Geographical Society, founded in 1852, and the next was the National Geographic Society, founded in Washington in 1888.

Among the members of these associations are men undertaking distant travels, in some cases at their own expense and in others aided by funds from the society or grants from the government. The information so collected is given to the world in lectures and in books or periodicals published by these organizations. Photography has been a great aid in recent years not only as a reliable and quick means of recording the striking features of a country and its inhabitants, but as a rapid and accurate method of topographical surveying.

The volumes of this work cover in their alphabetical place practically every topic touched in geography—continents, countries, cities, states, rivers, lakes, oceans, mountains, etc. In the last volume the topics are arranged in their proper order and related so that the reader can survey the whole field of geography.

The WONDROUS STORY *We* READ *in the* ROCKS

A Young Science that Peers Deep into the Abysses of the Ages—The Biography of Mother Earth and How to Read It in the Landscape and in the Ground beneath Your Feet

GEOLOGY. Geology is the science which deals with the history of the earth. It is the task of geology not simply to recite the history of the earth so far as it is known, but to show how this history became known and how the limits of knowledge are being extended. Geology is a young science, and in its study at the present time it is needful to take account of the limitations of present knowledge as well as of the knowledge itself.

Everything which throws light on the history of the earth falls within the field of geology. The history of the atmosphere and the history of the ocean are really parts of geology, since the atmosphere and the ocean are parts of the earth. The popular impression, therefore, that geology has to do only with the rocks of the earth is not altogether adequate. The rocks of the earth, to be sure, furnish the larger part of the data for unraveling the history of the earth, though they are not the only sources of information. It is to be remembered, too, that when the geologist studies the rocks, he studies them for the light they can be made to throw on earth-history, rather than for their own sake.

How Earth Rehearses the Story of Her Life

In working out the history of the earth, so far as it has been worked out, the line of approach has been through the study of the changes which are now taking place on the earth's surface. The rain falls on the land, and some of it gathers into streams, and the streams flow into the sea. In the flow of the water the substance of the land is worn away. The material is carried to the sea and deposited there in the form of gravel, sand, mud, etc. The sand and mud need nothing but cementation to become sandstone and shale, two of the commonest sorts of rocks found on the land. The process of cementation is now going on by natural means in many places. In the sand and the mud, as they are deposited in the sea, shells of various animals are imbedded. The shale and sandstone of the land also contain shells and other traces of marine animals known as fossils (*see* Fossils). Hence it is inferred that the sandstone and shale, as well as certain other sorts of rock found in the land, originally were deposited as beds of sand and mud in the sea, and that they have since been elevated so as to become dry land.

The activities of other surface agencies are studied similarly. The detailed study of the work now being done by rain and rivers, underground water, waves and currents, the atmosphere, glaciers, changes of temperature, gravity, organic agencies, and all other forces and activities operative on the surface of the earth, has taught geologists how to interpret the rocks formed in ages long past. It is by the interpretation of the recorded results oi the past, in the light of the processes now taking place, that the science of geology has grown up. The study of present processes is becoming more and more exhaustive, and the application of this increased knowledge of present processes to the records of the past is continually enlarging and perfecting our knowledge of the earth's history.

The Mystery in the World's Beginnings

Geology really begins with the origin of the earth, and at this point it touches the field of astronomy. The early ages of the earth's history are as yet speculative. There seems to be good reason for doubting the truth of the "nebular hypothesis," which was long regarded as satisfactory. The only rival hypothesis which has been framed is the "planetesimal hypothesis," which supposes that the earth is made up of an aggregation of small bodies comparable to the meteorites and shooting stars which daily reach the earth by millions at the present time. (*See* Meteors and Meteorites.) While the stages of the earth's history preceding the beginning of sedimentation are largely conjectural, many lines of investigation are being pursued which ultimately may throw much light on the early and obscure stages of the earth's development. The general outlines of this history since sedimentation began are fairly well understood.

The rocks of the earth which contain the principal records of the earth's history are of three great classes: (1) igneous rocks, or those which represent solidified lava; (2) sedimentary rocks, as shale, sandstone, conglomerate, etc., most of which are made up of fragments of older rocks; and (3) metamorphic rocks, which may have been so far altered by various means that they are now very unlike the materials from which they were first made. In the metamorphism of rocks, pressure is the most important agent. Chemical change, under the influence of moisture, is probably second in importance; and heat third. A special class of sedimentary rocks is due to life. Here belong most limestones, made of shells, corals, etc.; coal, of plant origin; and a number of lesser formations.

The composition, position, and structure of these several sorts of rock and their fossil contents, so far as they contain fossils, interpreted in the light of processes now taking place, allow geologists to infer the conditions under which the various sorts of rocks are made. When geologists are able to tell what the conditions were on every part of the earth at every period of the past, the science of geology will be complete.

Among the many branches of the science, economic geology is one of the most important. It deals with the materials of the earth's crust which are commercially valuable, and has to do with ores of all sorts, with coal, with building stone, with clays which are valuable for the manufacture of brick and pottery, and the like. It deals also with materials which can be used for pigments; sand, which can be used for glass; with precious stones; with abrasive materials; with asphaltum, petroleum, natural gas, salt, fertilizers, etc. One function of economic geology is to determine the origin of these substances and, so far as possible, the laws which govern their distribution.

Five Vast Chapters in Earth's Story

Geologic time is divided into five eras, and most of these are divided into several periods, as shown in the following table reading from the present to the remote past:

ERAS	PERIODS	
CENOZOIC	Quaternary (including glacial)	
	Pliocene	Tertiary
	Miocene	
	Oligocene	
	Eocene	
MESOZOIC	Upper Cretaceous	
	Lower Cretaceous	
	Jurassic	
	Triassic	
PALEOZOIC	Permian	Carboniferous
	Pennsylvanian	
	Mississippian	
	Devonian	
	Silurian (=Upper Silurian)	
	Ordovician (=Lower Silurian)	
	Cambrian	
PROTEROZOIC	Algonkian	
ARCHEOZOIC	Archean	

The Archeozoic era was the time occupied in the making of the oldest known system of rocks. The Archean rocks are mostly metamorphosed igneous rocks, though with them are some metamorphic sedimentary rocks. Fossils have not been found in this system of rocks, but it is certain that life existed before the close of this era.

The Proterozoic era is the time during which were deposited the great systems of rocks lying above the Archeozoic and below the oldest rocks containing abundant fossils. The rocks of the Proterozoic era are mainly sedimentary, though igneous rocks have great development locally. The formations of the Proterozoic era are many thousands of feet thick, though considerable portions have been removed by erosion. The Proterozoic era was perhaps as long as all subsequent time. Some forms of life existed during this era, as is shown by the few fossils which have been found in the rocks, and by the nature of some of the formations, even where fossils are wanting. For example, there are black shales and graphitic slates, the carbon of which probably is of plant origin. The Proterozoic (Algonkian) rocks of the Lake Superior region contain rich deposits of iron and copper.

The Paleozoic (formerly called Primary) era was the time when the several systems of rocks bearing the names Cambrian, Ordovician, Silurian, Devonian, Mississippian and Pennsylvanian (Carboniferous), and Permian were deposited. The time occupied in the deposition of each of these systems is a period. These systems of rocks are mainly of sedimentary origin, and the materials of which they are composed were derived from the land areas existing when these systems were being laid down. Most of the materials of the systems were washed down from the land to the sea, and there deposited. The several systems of Paleozoic rocks are distinguished from one another by their fossils. Thus, the fossils of the Cambrian system of rocks are sufficiently unlike those of the Ordovician system to be readily distinguished by those familiar with fossils.

Relics of the Pioneers in the Field of Life

Even at the beginning of the Cambrian period the range of life was great, all the great types which now live except the vertebrates being represented. Even the vertebrates may have lived, though relics of their existence have not been found. In this period trilobites and brachiopods seem to have been the most abundant and characteristic life. In the rocks of the Ordovician system fish remains have been found, and also relics of air-breathing life. Mollusks, crinoids, and corals lived in great profusion, in addition to the types of life which predominated in the Cambrian period. Most of the oil and gas of Ohio and Indiana come from rocks of Ordovician age.

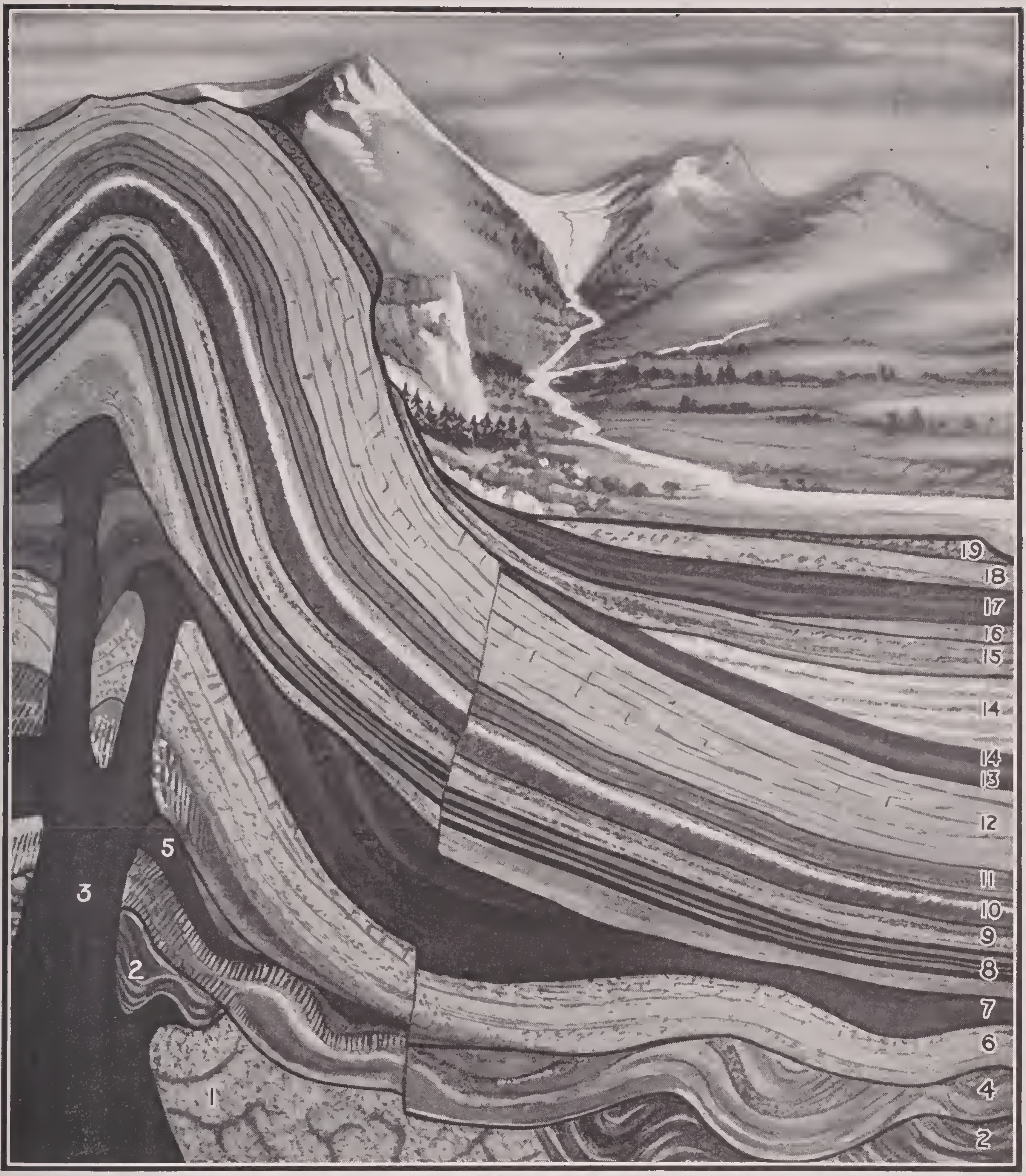
In the Silurian period the same general types of life were prevalent, but the species are so unlike those of the preceding period as to be readily distinguished by those familiar with fossils. The Devonian period is often known as the Age of Fishes, on account of the abundance of fish remains in the rocks of this system. It is far from certain, however, that fish were more abundant than now, and the variety of fish probably was less than at the present time. The Devonian was, however, the first period when fishes were abundant, so far as now known. The oil of Pennsylvania and Canada is largely derived from beds of Devonian age.

When Mother Earth Put in Our Winter Coal

During the Mississippian period, animal life seems to have become notably more abundant, and some beds of coal were formed, though coal is more characteristic of the next system. Much oil has been derived from the Mississippian system of rocks in Illinois. During the Pennsylvanian period there were extensive marshes in the United States and in some other parts of the world, in which vegetable matter accumulated in great quantity. These marshes (peat-bogs) subsequently were submerged, and the vegetable matter buried by mud, sand, etc., and ultimately converted into coal. Most of the coal of the United States east of the Great Plains was accumulated at this period. Plant life was abundant, but the plants were largely of types now extinct. Land animals of early reptilian types were common. The Mississippian and Pennsylvanian periods sometimes are called the Carboniferous period.

The Permian period represents a transition stage between the Paleozoic and the Mesozoic eras. In the Permian period there was extensive glaciation in Australia, South Africa, India, and South America.

THE STONE PAGES THAT TELL EARTH'S STORY



This picture illustrates how the old, old story of the Earth was written, so to speak, in the successive layers of stone laid down age after age and how geologists have been able to read it owing to the fact that the strata or "pages" are exposed by being wrinkled up into mountains and worn away by wind and weather and flowing streams. The great vertical crack running down the center of the picture is what is known as a "fault." The sudden development of such a break and the sinking of the rocks on one side is one of the causes of earthquakes, especially in mountain regions. In reading the stone book, you must start, not at the top, but at the bottom—the order in which the layers were formed. The oldest rock formation (1) consisting of gneiss, granite, and schist, is called Archean, meaning "ancient" and the era in which it was made is known as Archeozoic, meaning "ancient life." The next (2) is called Algonkian, formed in the Proterozoic era. The black vertical formation (3) is not one of the regular strata, but "trap rock" formed by molten stone which has welled up and broken through the layers above. The others in their order are Cambrian (4), Ordovician (5), Silurian (6), Devonian (7), Carboniferous or "coal-bearing" (8), which includes also Permian (9); then come Triassic (10), Jurassic, including Liassic (11), and Oölitic (12); Lower Cretaceous (13), and Upper Cretaceous (14); Eocene (15), which marks the beginning of the "Age of Mammals"; Oligocene (16), when the forerunners of the most of the present-day mammals began to take shape; Miocene (17), when such creatures as the mastodon appeared; Pliocene (18), which probably marks the beginning of the "Age of Man." The rock systems of the Quaternary period are the Pleistocene (19), formed about the time when man was struggling against the cave-bear and the mastodon, and the uppermost layer of comparatively modern origin, called the Holocene or "Recent." These rocks differ from each other in chemical composition, the character of fossils they contain, and in various other ways; but when you remember that countless ages of earthquakes, upheavals, and subsidences have mixed them together, you will appreciate what a task it has been to read their lesson correctly.

The several systems of Paleozoic rocks have somewhat different distribution, and, since the area of the deposits of any period corresponds approximately with the submerged area of that period, the distribution of the several systems helps us to understand the relations of land and water during the several periods. In this way it is known that the relations of sea and land were different at different times. It would appear either that the continent repeatedly rose and sank, causing areas which were at one time submerged to become land, and vice versa; or that the sea-level itself rose and fell. If the sea-level rose, it would overspread the low lands; if it were lowered, it would cause areas which had been submerged to become land. How far the many changes in geography during the Paleozoic era were the result of land oscillations, and how far they were the result of oscillations of sea-level, never has been determined. So far as present knowledge goes, it would appear that the deep-sea bottom has at no time been land, and that the areas which were alternately above and below sea-level were low when they were land, and covered by shallow water only when they were submerged.

When Giant Reptiles Ruled the Land

The Mesozoic (formerly called Secondary) era, as the term indicates, was the era when life intermediate between the ancient and the present existed. This era is divided into several periods, as indicated above. The Triassic formations of North America are somewhat widespread in the western third of the continent, but have but little development in the eastern part. During this period reptiles perhaps were the dominant type of life. They were not only numerous but the individuals attained great size (*see* Animals, Prehistoric). The earliest known remains of mammals date from this period. Marine life abounded, but departed notably from the types which had prevailed in the Paleozoic era. Vegetation was abundant, but of types now extinct or rare.

The Jurassic period followed, and the distribution of its formations is similar to that of the Triassic formations. The life of this period was somewhat different from that of the preceding, though the same general types abounded. Reptiles were the most distinctive type, and they were even larger than in the preceding period. The oldest remains of birds yet found are Jurassic.

The Jurassic period was followed by the Cretaceous (Chalk) periods. In the early part of the first period chalk was not being deposited, but in the later part chalk deposits were in process of formation in many parts of the earth. The chalk deposits are made up, for the most part, of the shells of minute marine animals (*see* Chalk). The Cretaceous formations of North America are much more widespread than those of the Jurassic and Triassic periods. Their distribution indicates that a large part of the North American continent was submerged during part of the later Cretaceous periods. It was during the Upper Cretaceous that modern types of plants and fishes made their appearance. During the last stages of the Cretaceous periods extensive coal beds were laid down in the western United States.

Exit the Monsters; Enter the Mammals

The Cenozoic era, or era of modern life, followed the Mesozoic. Mammals, the earliest remains of which were found in the rocks of the Triassic system, abounded during the Cenozoic era, while the huge reptiles which had been especially characteristic of the Mesozoic era had disappeared. Reptiles still existed, but they were of relatively small types, and their numbers appear to have been few. As the Cenozoic era progressed, the forms of life approached more and more closely to those of the present time, and by the end of the Pliocene the life was nearly the same as that which now exists.

One theory ascribes this change from Mesozoic to Cenozoic life to a change in climate and ground surface. Before the change much of the ground was marshy, and since under such conditions size and power were more important than speed for survival, ponderous reptile forms dominated the earth. Then geologic changes drained off the water, created large areas of hard ground surface suited to running, and supplanted the luxurious swampy vegetation with modern "dry land" flowering plants. These changes gave the running types of animal, with their speed and ability to range far in search of food, an advantage over the clumsy giant reptiles, which therefore gradually became extinct.

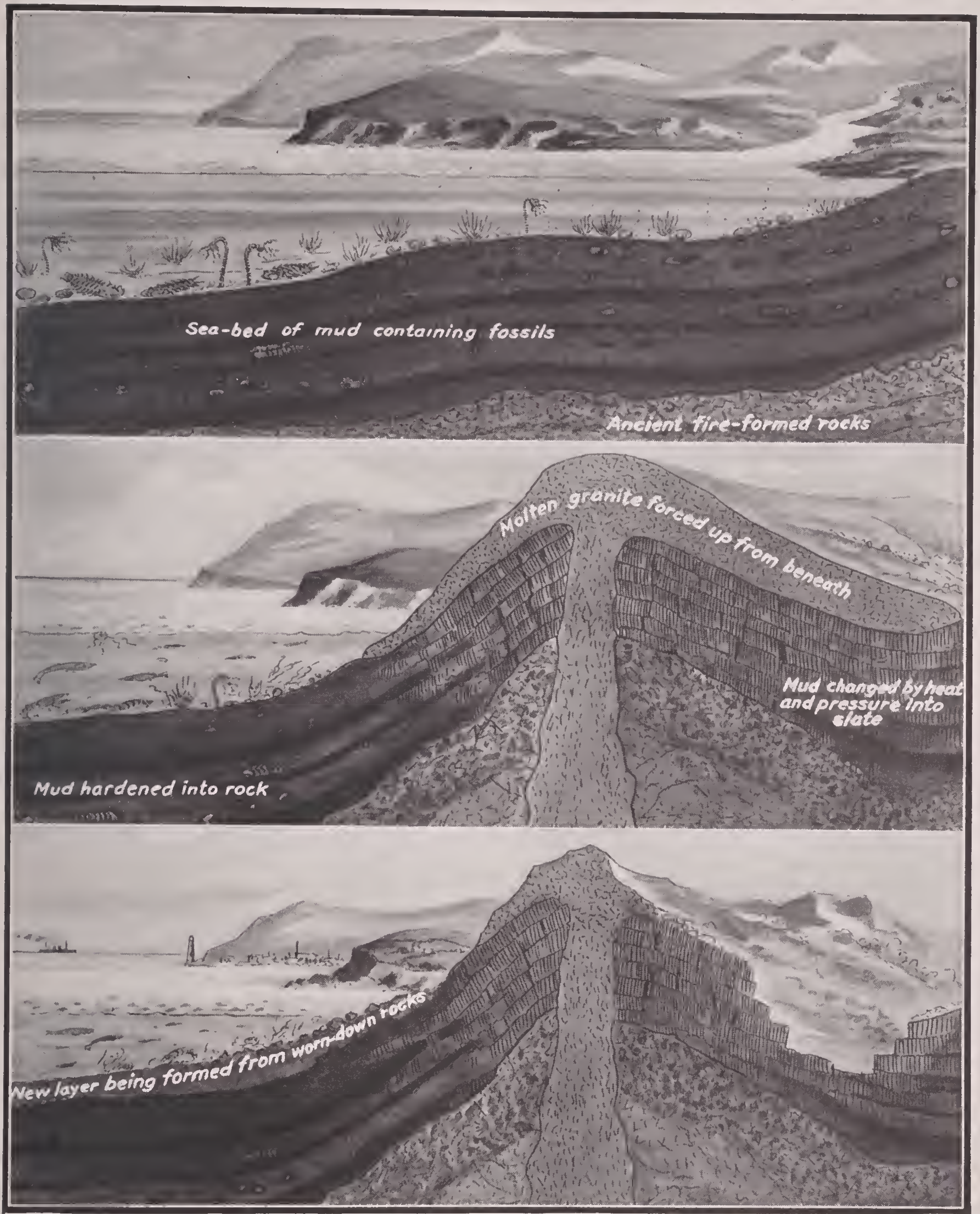
The Quaternary (Pleistocene) period was a remarkable one, on account of the great climatic changes which occurred at this time. The result of these climatic changes brought on a glacial climate, and an ice-sheet or series of ice-sheets covered something like 4,000,000 square miles in the northern part of North America. A large ice-sheet was developed, probably contemporaneously, on the continent of Europe, affecting especially its northwestern part (*see* Ice Age).

The duration of the earth's history is a matter which has received much attention, but no conclusions have been reached which can be relied upon, beyond the very general one that the history of the earth has been exceedingly long (*see* Earth). Various conjectures as to the number of years occupied in bringing the earth to its present condition have been made. They range from 25,000,000 years or so to 1,500,000,000 since the time of the formation of the oldest rocks now accessible. As stated above the Archeozoic era probably was longer than all subsequent time put together. The Proterozoic era was perhaps as long as all that followed. The Paleozoic era was perhaps two or three times as long as the Mesozoic, and the Mesozoic probably was considerably longer than the Cenozoic.

Great Changes in Climate

The climatic changes which the earth has undergone have been great, but their causes are not well understood. There is little basis for the belief, formerly widespread, that the climate has on the whole been growing cooler. Cold periods seem to have alternated

HOW SCHOOL SLATES COME OUT OF THE SEA


Sea-bed of mud containing fossils
Ancient fire-formed rocks
Molten granite forced up from beneath
Mud changed by heat and pressure into slate
Mud hardened into rock
New layer being formed from worn-down rocks

This series of pictures illustrates the processes by which certain kinds of rock are made. In the first picture we see a bed of mud beneath the sea containing fossils and overlying the ancient fire-formed rocks. Ages later, perhaps, an immense fold of the earth's crust split and masses of molten rock welled up from below, flowing out over the surface. The heat and pressure of this molten mass turned the mud rock into slate. Then, thousands and thousands of years later, part of the granite was worn away by the flowing waters of a river, leaving the slate exposed. On the other side of the cliff you see the sea grinding more rock into mud, which may perhaps in the course of the ages be buried beneath another eruption of molten rock and harden into a new layer of slate. And so the Old Earth goes on changing its skin, shifting its waters, and working over its raw materials. The process may seem slow to us, but Nature has "all the time in the world" to do her work. Indeed, when you think that all recorded history only reaches back some 6,000 years, and that a million years, or more than a hundred times the span of all human history, is only a small period in geologic time, you can see how deliberately Nature proceeds about her tasks.

with warmer ones. There was local glaciation in the Paleozoic era, and extensive glaciation at the close of the Paleozoic. There was glaciation in the early Cenozoic era and very extensive glaciation later in that era; and there is some indication of cold periods at other times. On the other hand the lands of high latitudes enjoyed genial climates during some parts of the earth's history, even as late as the mid-Tertiary time.

Volcanic activity seems to have been greater at some periods than at others, but on the whole it seems to have been about as great, so far as now known, in late as in early stages of the earth's history, if the Archeozoic era be excepted.

The SCIENCE *that Measures* ANGLES, SURFACES, SOLIDS

***N**EXT to arithmetic no other branch of mathematics is so frequently used in our daily life as is geometry. When the farm or city lot and street on which you live were measured off and their boundaries determined, geometry was put to use. When architects planned and carpenters built your house and determined its lines and the steepness of the roof, they measured angles and lines and used geometry. When ships sail the sea to bring your food and clothing, their course and their cargo capacity have been based on geometrical knowledge. When you read in this book about the height of mountains, the boundaries of states and countries, or even examine the diagram of how a baseball diamond is laid out, you are learning of geometry and its applications.*

GEOMETRY. As its Greek name indicates, geometry (from *geo,* "earth," and *metron,* "measure") had its origin long ago in earth measurement, not with the Greeks, but before them with the Babylonians and Egyptians. The lands of Egypt swept by the floods of the Nile had often to be resurveyed and measured to establish the vanished boundaries; and in 2000 B.C. the rope stretchers or surveyors of Egypt had their crude way of erecting a perpendicular and knew without formal demonstration that the square on the hypotenuse of a right triangle whose sides were 3, 4, 5, is equal to the sum of the squares on the other two sides. Even in building the pyramids some applications of geometry were necessary. The reasoning mind of the Greek made of all this a body of mathematical knowledge that had to do with the measurement of space. "Plane geometry" deals with circles, angles, squares, etc.; that is, it is two-dimensional; and "solid geometry" with cubes, spheres, and other three-dimensional bodies.

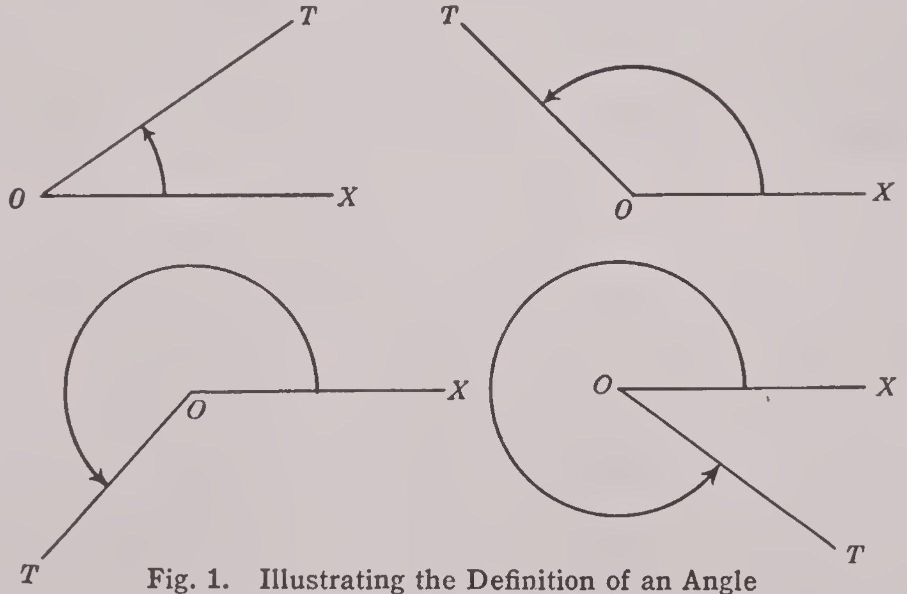


Fig. 1. Illustrating the Definition of an Angle

In the history of the Greek development of geometrical reasoning there are many names, but three stand out: Thales (640 B.C.–about 550 B.C.), one of the "seven wise men," is credited with originating the geometry of lines and angles and developing demonstrations of things which others took for granted. Pythagoras, his pupil (569 B.C.– about 500 B.C.). and the members of the great Pythagorean school studied mathematics in secret. Pythagoras is known to have proved that *the square on the hypotenuse of a right triangle is equal to the sum of the squares on the other two sides,* and this is known as the Pythagorean theorem. Euclid (about 300 B.C.) is the one name known when all others are forgotten in the history of geometry; his work has been the standard almost down to our own day.

The student who approaches the study of geometry must be thoroughly familiar with the measuring of lines—that is, from point to point—by practice with a rule, a compass, or squared paper ruled to inches and fractions of an inch. When he applies this to measuring a room it is with the object of applying another fundamental idea of geometry, that of ratio. When we say a room is ten yards long we mean that it is ten times as long as the standard unit, a yard; that is, the ratio of the yardstick to the length of the room is as 1 to 10. The ratio is the quotient of one number divided by another, $\frac{10}{1}$. Every measurement is the determination of a ratio of some sort and is often expressed as a fraction.

From these simple exercises we may proceed to some of the simpler geometrical constructions that arise out of the relation of lines to one another and to the definition of the basic terms used in geometry.

If a straight line, as *OX* in any of the drawings of Fig. 1, rotates in a plane about a fixed point, as *O,* in the direction indicated by the arrowheads (counterclockwise) until it reaches the position *OT,* it is said to turn through the angle *XOT.* Thus, an angle is the amount of turning made by a line rotating about a fixed point in a plane (flat surface). As the rotation continues, the size of the angle increases.

Vertex.—The fixed point O is called the vertex of the angle.

Initial and Terminal Sides.—The line OX is called the initial side of the angle. The line OT is called the terminal side.

Symbol for Angle.—The symbol for "angle" is $\angle$; for "angles" it is $\angle$s. Thus, Angle XOT is written $\angle\ XOT$.

Kinds of Angles.—If a line rotates about a fixed point in a plane so as to make one-fourth of a complete turn, the angle formed is called a "right angle" (rt. $\angle$). (*See* Fig. 2*a*.)

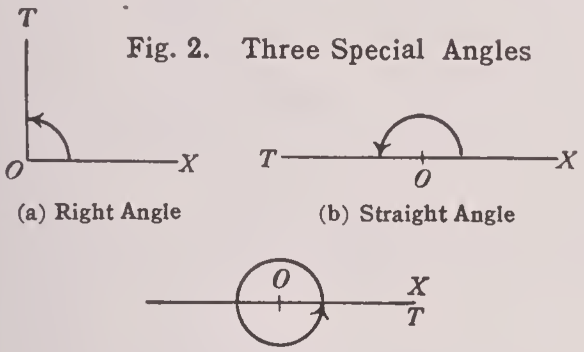


Fig. 2. Three Special Angles

(a) Right Angle (b) Straight Angle

(c) Perigon

If the line makes one-half of a complete turn, the angle formed is called a "straight angle" (st. $\angle$). (*See* Fig. 2*b*.) If the line makes a complete turn, the angle formed is called a *perigon*. (*See* Fig. 2*c*.)

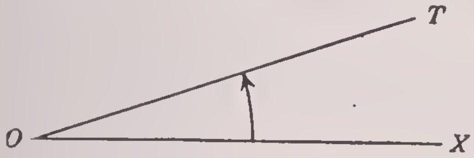


Fig. 3. Acute Angle

Angles are further classified upon the basis of their relation to the right angle, the straight angle, and the perigon. An angle less than a right angle is called an "acute angle" (Fig. 3). An angle which is greater than a right angle and is less than a straight angle is called an "obtuse angle" (Fig. 4). An angle greater than a straight angle and less than a perigon is called a "reflex angle" (Fig. 5).

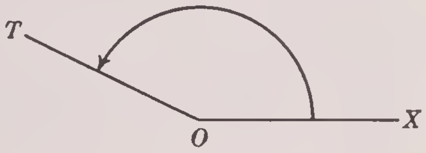


Fig. 4. Obtuse Angle

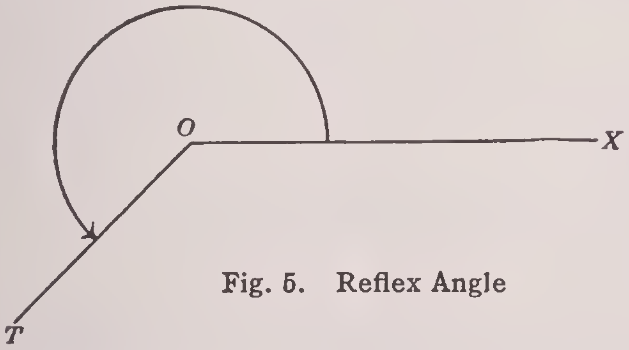


Fig. 5. Reflex Angle

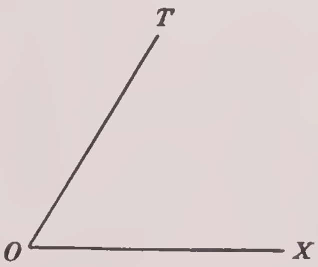


Fig. 6

Notation for Reading Angles.—There are three common methods by which one may denote angles: (1) Designate the angle formed by two lines OX and OT, as the "angle XOT" or the "angle TOX". Here the first and last letters denote points on the lines forming the angle, and the middle letter denotes the point of intersection (the vertex). In reading "angle XOT" we regard OX as the initial side and OT as the terminal side. (2) Denote the angle by a small letter placed as x in Fig. 7. In writing equations this method is the most convenient. (3) Denote the angle by the letter which is written at the point of intersection of the two sides of the angle, as "angle A." This last method is used only when there is no doubt as to what angle is meant.

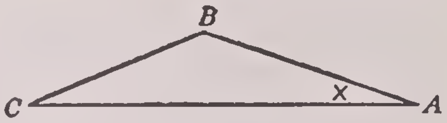


Fig. 7

If a line OX be taken as the initial side of an angle (*see* Fig. 8), and the line be rotated one complete turn (a perigon), any point, as P, on the line OX will trace a curved line which we call a "circle." Thus *a circle is a closed curve, all points of which lie in the same plane and are equally distant from a fixed point.*

The following terms are used in connection with the circle:

Center and Circumference.—The fixed point O is the "center" of the circle. The length of the curve (circle) is called the "circumference" (distance around) of the circle.

Radius and Diameter.—A line drawn from the center of a circle to any point on the circle is a "radius." Thus, $O\,P$ is a radius of the circle. A line connecting two points on the circle and passing through the center of the circle is called a "diameter."

From the definition of "radius" given above it is clear that in a given circle or in equal circles one radius has the same length as any other. Thus we obtain the following important geometric relation: *Radii of the same circle or of equal circles are equal.* ("Radii" is the plural of "radius.")

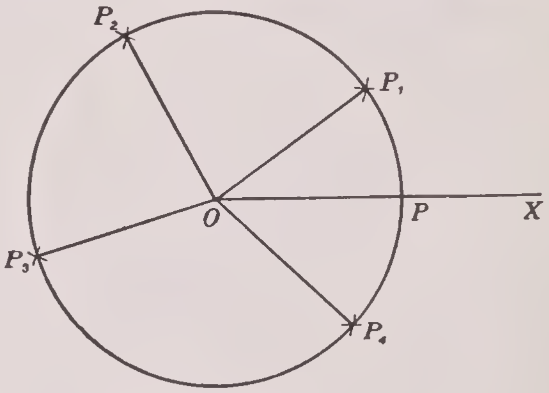


Fig. 8. The Circle

Ratios and Measurcments. The circumference of a circle has a certain ratio to the diameter which is denoted by the Greek letter *pi* (π). The value of π is usually taken as 3.1416. The circumference of a circle, therefore, is expressed by the formula $2\pi r$, and the area by πr^2, in which r is the length of the radius.

Arc; to Intercept; Central Angle.—An "arc" is a part of a circle. If two radii are drawn from the center of the circle to two different points on the circle, they cut off an arc on the circle. The symbol for "arc" is $\frown$. Thus, $\frown AB$ is read "the arc AB." The angle formed at the center of the circle is said to "intercept" the arc. The angle at the center is called a "central angle."

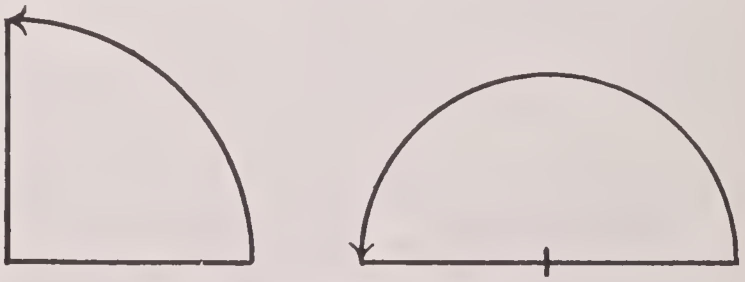


Fig. 9. Quadrant and Semicircle

Quadrant and Semicircle.—An arc equal to one-fourth of a circle is called a "quadrant." An arc equal to one-half of a circle is called a "semicircle" (Fig. 9).

How We Measure Angles.—In many instances the process of measuring angles is as important as that of measuring distances. An angle is measured when we find how many times it contains another angle selected as a unit of measure.

The "protractor" is an instrument devised for measuring and constructing angles. The protractor commonly consists of a semicircle divided into 180 equal parts. Each of these equal parts is called a degree of arc (1°). In the geography work in the grades, the unit for longitude and latitude was the degree of arc. In the measurement of angles we shall consider a unit corresponding to a unit of arc and called a "degree of angle."

If straight lines are drawn from each of these points of division on the semicircle to the center O, 180 equal angles are formed, each of which is a degree of angle (1°). Thus, the "unit" of angular measure is the "degree." A degree is divided into 60 equal parts, each of which is called a "minute" (1′).

Each minute is divided into 60 equal parts, each of which is called a "second" (1″). Of course the minute and the second graduations are not shown on the protractor.

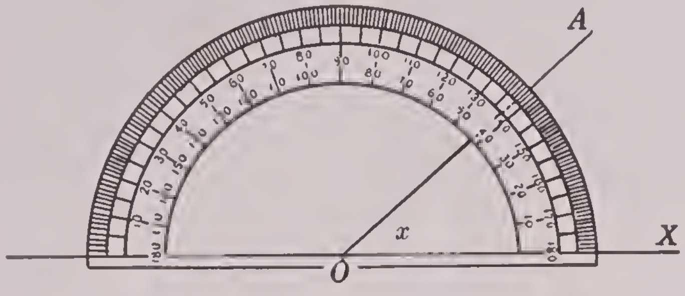


Fig. 10. Measuring Angles with a Protractor

How to Use the Protractor.—The protractor may be used to measure a given angle. Thus, to measure a given angle x place the protractor so that the center of the protractor (point O in Fig. 10) falls upon the vertex and makes the straight edge of the protractor coincide with (fall upon) the initial side of the given angle x. Now, observe where the terminal side of the given angle intersects (crosses) the rim of the protractor. Read the number of degrees in the angle from the scale on the protractor.

The protractor is also useful in constructing angles of a required size. For example, to construct an angle of 42° draw a straight line OX (Fig. 10) and place the straight edge of the protractor on the line OX so that the center rests at O. Count 42° from the point on OX where the curved edge touches OX and mark the point A. Connect A and O, and the angle thus formed will contain 42°.

Some Simple Problems in Construction

One of the important phases of geometry work is that of constructing perpendiculars, angles, parallel lines, and so on.

For example, let us consider the following problem:

At a given point on a given line to erect a perpendicular to that line by using ruler and compasses.

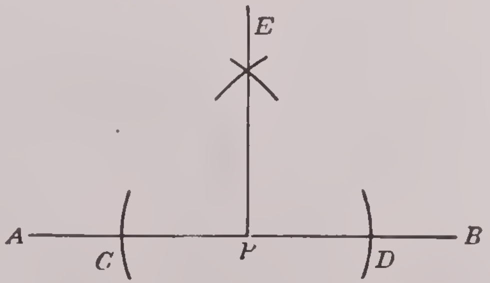


Fig. 11. How to Erect a Perpendicular

Construction: Let AB be the given line and P the given point (Fig. 11). With P as a center and with a convenient radius draw arcs intersecting AB at C and D.

With C and D as centers and with a radius greater than $\frac{1}{2}$ CD draw intersecting arcs. Call the point of intersection E, and draw EP. Then EP is the required perpendicular.

Another well-known construction problem is this:

At a given point on a given line to construct by means of a ruler and compasses an angle equal to a given angle.

Construction of an Angle.—Let DEF in Fig. 12 be the given angle and let P be the given point on the given line AB.

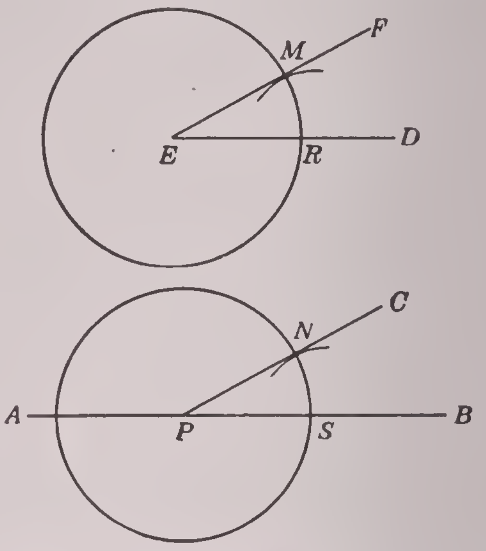


Fig. 12. Constructing an Angle Equal to a Given Angle

With E as a center and ER as a radius, draw a circle. With P as a center and with the same radius (ER) draw another circle. Place the sharp point of the compasses at R and cut an arc through M. With S as a center and the same radius cut an arc at N.

The $\angle BPC$ is the required angle.

Definitions.—If two lines form right angles with each other, they are said to be "perpendicular." The symbol for "perpendicular" is ⊥. The meaning of "parallel lines" is shown by Fig. 13. AB and CD in that figure have had the same amount of angular rotation from the initial line EF. Thus, they have the same direction and are said to be "parallel." The symbol for "parallel" is ‖. Thus, $AB \parallel CD$, is read "AB is parallel to CD."

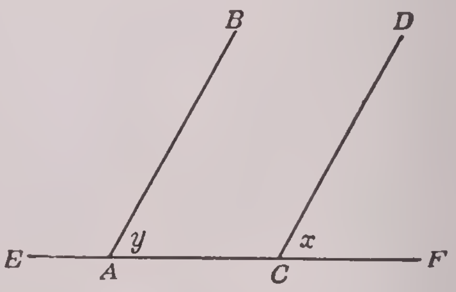


Fig. 13. Parallel Lines

Angles x and y in Fig. 13 are called "corresponding" angles. The line EF is called a "transversal." It is clear that the lines are parallel only when the corresponding angles are equal and that the corresponding angles are equal only when the lines are parallel.

Another important construction problem is that of drawing a line parallel to a given line. This we shall now explain.

Construction: Choose a point P outside the given line AB (Fig. 14). Draw a line through P so as to form a convenient angle x with AB. Call the point of intersection D. At P, using DP as initial line, construct an angle y equal to angle x (use method shown in Fig. 12). Then PR and AB are parallel because they have had the same amount of rotation from the initial line PD.

If one pair of parallel lines cross (intersect) another pair, the four-sided figure thus formed is called a "parallelogram"; that is, *a parallelogram is a quadrilateral whose opposite sides are parallel.*

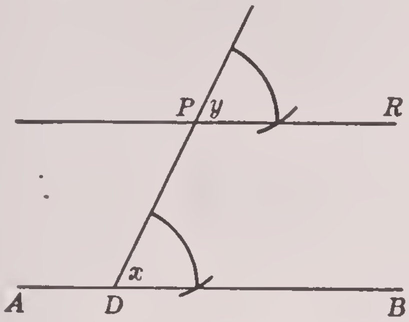


Fig. 14. **How to draw Parallel Lines**

If we remember the method used for constructing one line parallel to another, it will be easy to construct a parallelogram.

Construction: Draw a working line AB (Fig. 15). Draw AR making a convenient angle with AB. Through any point, as P, on AR draw a line PV parallel to AB. Through any point as M on AB draw a line MT parallel to AR. The figure $AMSP$ is a parallelogram, for its opposite sides are parallel.

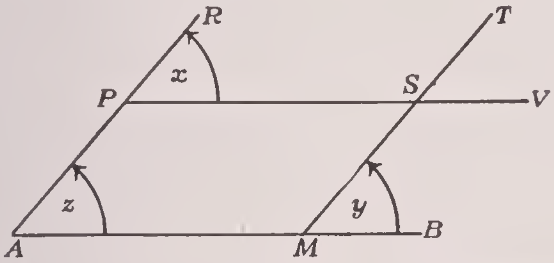


Fig. 15. **How to construct a Parallelogram**

If one of the interior angles of a parallelogram is a right angle, the figure is a *rectangle* (Fig. 16). Thus, *a rectangle is a parallelogram in which one interior angle is a right angle.* If all the sides of a rectangle are equal, the figure is called a "*square*" (Fig. 17).

Fig. 16

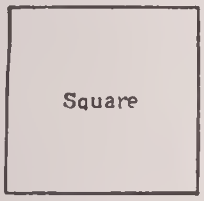


Fig. 17

If we determine the amount of area inclosed within a polygon, or several-sided figure, as in the triangle ABC in Fig. 18, we are *measuring the area* of the triangle. As in measuring length, the process is one of comparison. We compare the area of the given polygon with some standardized (defined and accepted) unit of area and determine how many units are contained in the polygon; that is, we determine the ratio between the area of the given polygon and a standard unit of area.

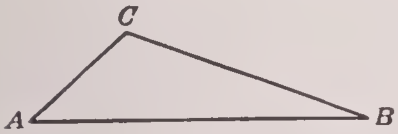


Fig. 18

The unit of area is a square, each of whose sides is a standard unit of length. Such a unit involves length and width. Thus, we may measure area and express the result in square feet, square inches, square meters, square centimeters, etc.

The drawings in Fig. 19 represent geometric solids. A solid is commonly thought of as an object that occupies a portion of space. It is separated from the surrounding space by its surface. In geometry we study only the form of the solid and its size. We are not interested in color, weight, etc. A solid differs from the figures we have been studying in that it does not lie altogether in a plane, but involves a third dimension.

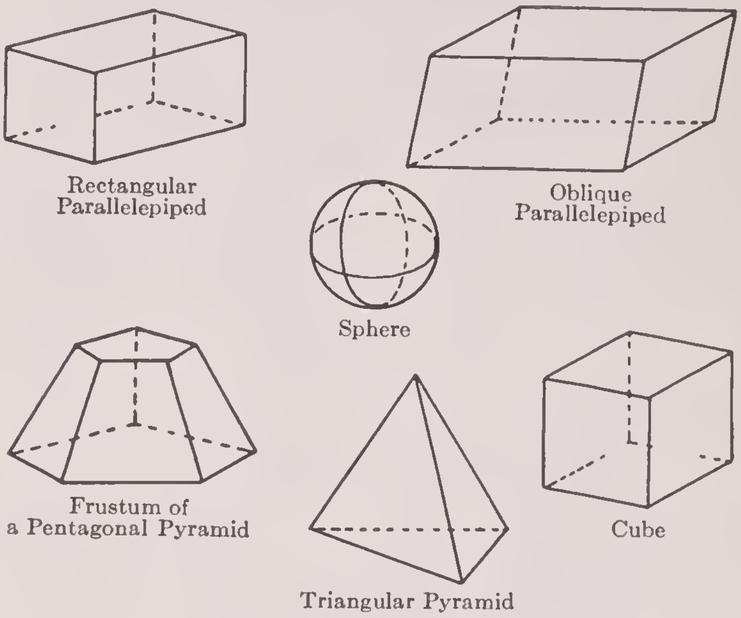


Fig. 19. **Familiar Solids**

Cube.—The cube has six faces all of which are squares. Two faces intersect in an edge.

Oblique Parallelepiped.—The faces of an oblique parallelepiped are all parallelograms.

Rectangular Parallelepiped.—The faces of a rectangular parallelepiped are all rectangles.

Measurement of Volume; Unit of Volume.—When we determine the amount of space inclosed within the surface of a solid we are measuring the "volume" of the solid. To measure the volume of a solid we compare the solid with a cube each of whose edges equals a unit of length. The volume is expressed numerically by the number of times the unit cube goes into the solid. The unit cube is called the *unit of volume.*

Essential Terms Defined

It is equally important that we should keep clearly in mind the definitions of certain geometrical terms.

Theorem.—In our geometry work we are concerned mostly with the proving of certain geometric relations. For example, we may prove that "The sum of the interior angles of a triangle is a straight angle." Such a statement of a geometric relation is called a "theorem." Thus a theorem is something to be proved.

Problem.—A "problem" in geometry is something to be done. Thus "To draw a perpendicular to a given point in a line" is a problem.

Proposition.—A "proposition" in geometry may be either a theorem or a problem.

Exercise.—A theorem or problem is often called an "exercise."

Corollary.—A truth which may grow out of or depend upon the truth of a proposition is called a "corollary."

In geometry we should know the following:

Outline of angle pairs formed by two lines cut by a transversal. When two lines are cut by a transversal, as in Fig. 20—

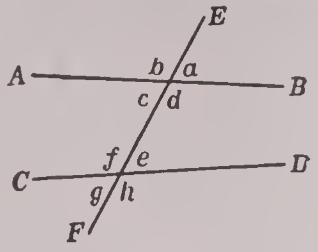


Fig. 20

angles c d, e, f, are called "interior" angles;
angles a, b, g, h, are called "exterior" angles;

the angles of the angle pairs a and e, b and f, d and h, c and g are called "corresponding" angles;

the angles of the angle pairs d and e, c and f are called "interior" angles on the *same side* of the transversal;

the angles of the angle pairs d and f, c and e on *opposite* sides of the transversal are called "alternate-interior" angles;

the angles of the angle pairs b and h, a and g on *opposite* sides of the transversal are called "alternate-exterior" angles.

The student of geometry should be careful to remember—

(a) that corresponding angles are equal;
(b) that alternate-interior angles are equal;
(c) that alternate-exterior angles are equal;
(d) that interior angles on the same side of the transversal are supplementary

only when the lines cut by the transversal are parallel.

Geometrical Methods of Proof

In geometry we have various methods of proving propositions. There is no one particular or invariable method of proof. The student of geometry should therefore become familiar with these methods. We shall explain each and illustrate some by examples.

The demonstration of a theorem consists of three parts: the part that is given (the *hypothesis*), the part that is to be proved (the *conclusion*), and the *proof*. And in proving a theorem one should give a reason for each step taken.

The briefest general directions for proving a proposition are:

(1) Be sure to read the proposition carefully.

(2) If the proposition is a theorem or exercise, draw a careful general figure, i.e., if the theorem concerns a triangle draw a triangle all of whose sides are unequal (scalene) and not one, all of whose sides are equal (equilateral) or one, two of whose sides are equal (isosceles).

(3) Write down clearly the hypothesis (the given part) and the conclusion (what is to be proved) and do this in terms of the letters in your figure.

(4) Try to work out the proof by falling back on anything you have previously learned that may apply, or draw some construction line or lines that may suggest the proof.

(5) Follow the outline given below for the form of your proof.

This makes it necessary to base each statement on (1) the hypothesis, (2) an axiom, (3) a definition, or (4) some other theorem which has previously been proved by geometrical methods.

The following proof will serve as an illustration: The theorem is: *The sum of the interior angles of a triangle is 180°* (Fig. 21).

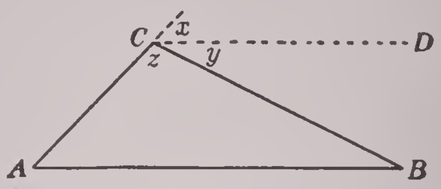


Fig. 21

Hypothesis: Triangle ABC.
Conclusion: $\angle A+\angle B+\angle C = 180°$.
Proof:

STATEMENTS	REASONS
Draw $CD \parallel AB$.	
Then $\angle x = \angle A$.	Because corresponding angles formed by two parallel lines cut by a transversal are equal.
And $\angle y = \angle B$.	Because alternate-interior angles formed by parallel lines cut by a transversal are equal.
But $\angle x+\angle y+\angle z = 180°$.	Because the sum of all the angles about a point in a plane on one side of a straight line is 180°.
$\therefore \angle A+\angle B+\angle C = 180°$.	By substituting $\angle A$ for $\angle x$, $\angle B$ for $\angle y$, and $\angle C$ for $\angle z$.

At the end of such a demonstration we generally write Q. E. D. (*Quod erat demonstrandum*, "which was to be demonstrated"); or if it is a proposition, Q. E. F. (*Quod erat faciendum*, "which was to be done").

METHOD OF PROOF BY SUPERPOSITION. The method of proof by superposition is the method used to show that certain figures have the same shape and same size (congruent figure). The symbol for "congruent" is $\cong$. It is the method always used to prove two triangles congruent when two sides and the included angle of one are equal respectively to two sides and the included angle of the other. The proof is as follows (Fig. 22):

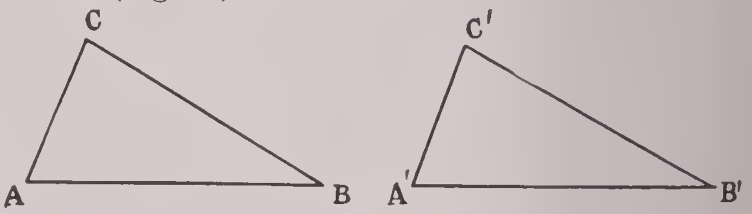


Fig. 22

Hypothesis: $\triangle ABC$ and $\triangle A'B'C'$ with $AC = A'C'$, $AB = A'B'$ and $\angle A = \angle A'$.
Conclusion: $\triangle ABC \cong \triangle A'B'C'$.
Proof:

Imagine the triangle ABC placed upon the triangle $A'B'C'$ so that angle A shall fit exactly upon its equal angle, A', AB falling upon $A'B'$ and AC upon $A'C'$.

Then since AB is given equal to $A'B'$, B will fall upon B' and since AC is given equal to $A'C'$, C will fall upon C'.

Then BC will fall along and coincide with $B'C'$, else there would be two different straight lines connecting the two points B and C, and this is evidently impossible because only one straight line can be drawn between two points.

Hence, the two triangles are congruent, i.e., they coincide, or fit.

Since ABC and $A'B'C'$ are any two triangles having two sides and the included angle of one equal to the corresponding parts of the other, the theorem is true.

METHOD OF PROOF BY CONGRUENT TRIANGLES. In order to prove that certain lines or angles are equal it is often expedient to show that the lines or angles are corresponding (homologous) parts of congruent triangles and are therefore equal.

For example, let us suppose we want to show that the base angles of an isosceles triangle are equal. To do this we would bisect the vertex angle of the isosceles triangle and then prove the two triangles thus formed congruent. The base angles of the original isosceles triangle would then be corresponding parts of the two little congruent triangles and therefore would be equal.

INDIRECT METHOD. The indirect method or *reductio ad absurdum* (reducing to an absurdity) method is one that is sometimes employed in geometry. The following proof will illustrate:

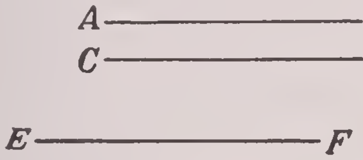


Fig. 23

Theorem: If each of two lines is parallel to a third line, they are parallel to each other (Fig. 23).

Given: AB and CD each parallel to EF, to prove $AB \parallel CD$.

Proof:

STATEMENTS	REASONS
Suppose AB is not parallel to CD and that they meet at some point P. Then, through P there would be two lines parallel to EF which is impossible.	Because through a point outside a given line only one line can be drawn parallel to the given line.
Therefore AB and CD lying in the same plane do not meet. Hence they are parallel.	Because when two lines lie in the same plane and do not meet, they are parallel.

METHOD OF ANALYSIS. The method of analysis is a very powerful and useful method in geometry, especially in construction work.

Let us take the following problem as an illustration: From a point outside a circle to draw a tangent to the circle.

Given: a circle whose center is O and a point P outside the circle (Fig. 24).

Required: to draw a line from P tangent to the circle.

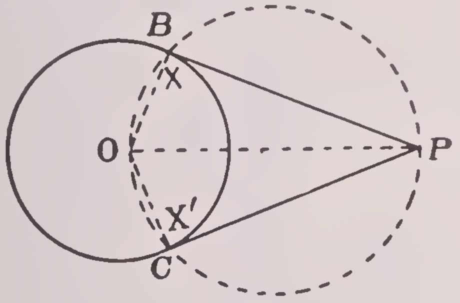


Fig. 24

Analysis: Imagine the two possible tangents drawn. Connect O and P. Draw OB and OC. Then if PB and PC are to be tangent to the circle, $\angle x$ and $\angle x'$ must be right angles, because a tangent to a circle is $\perp$ to a radius drawn to the point of contact. This suggests the construction, for we know that if a second circle is drawn on OP as a diameter, $\angle x$ and $\angle x'$ will be right angles, because all angles inscribed in a semicircle are right angles. (An angle is said to be "inscribed" when it is made between two lines, one of which runs from any point such as X on the dotted semicircle to one end of the diameter, O, while the other runs from the point X to the other end of the diameter, P. It can be proved, although the proof is not given here, that such an angle in a semicircle is always a right angle.)

Construction: Start with given circle and point P outside. Draw OP. Then on OP as a diameter construct a circle. Draw PB and PC and they are the required tangents.

Proof:

STATEMENTS	REASONS
Draw radii BO and CO. Then $\angle x$ and $\angle x'$ are each right angles.	Because any angle inscribed in a semicircle is a right angle.
Then BP and PC are tangent to the circle.	Because a line drawn perpendicular to a radius at its outer extremity is tangent to the circle.

CONVERSE. The "converse" of a proposition is another proposition such that what is given in the first is to be proved in the second and what is to be proved in the first is given in the second.

For example, "An equiangular triangle is equilateral" is the converse of "an equilateral triangle is equiangular" (Fig. 25). Not all converse propositions are true. The one above is true, but consider the following: "All congruent triangles are similar." Conversely, "All similar triangles are congruent" is not true.

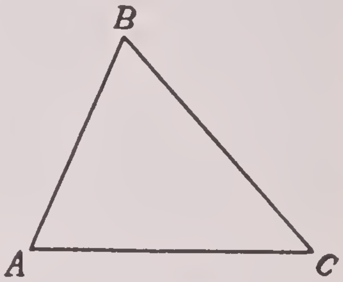


Fig. 25

METHOD OF PROOF BY ELIMINATION. The method of proving a proposition by eliminating all of the possibilities except one is sometimes used in geometry. For example, let us take the theorem, *In any triangle where two sides are unequal, the angles opposite these sides are unequal in the same order.*

Given: $\triangle ABC$ with $AB < AC$.

To prove: $\angle C < \angle B$.

Proof:

STATEMENTS	REASONS
There are three possibilities: (1) $\angle C = \angle B$ (2) $\angle C > \angle B$ (3) $\angle C < \angle B$	
$\angle C$ cannot equal $\angle B$.	Because if it were, AB would equal AC and this is not true.
$\angle C$ is not greater than $\angle B$.	Because if it were, then $AB > AC$ and this is not true.
Therefore $\angle C < \angle B$	By eliminating the other two possibilities.

DIRECT OR SYNTHETIC METHOD. The direct or synthetic method is the one commonly employed by textbook writers for setting down their proofs. It is logically ordered and more elegant than the analytic method. An example is given in Fig. 21 where the theorem *The sum of the interior angles of a triangle equals 180°* is proved. This method is the highly finished method and is the one which we use to write out our final proof in a most finished form.

The reader should endeavor to master all of the methods given here and consult the ordinary school textbooks for illustrative material.

More advanced branches of geometry than the plane and solid are "*analytical geometry,*" a combination of algebra and geometry which can be studied after one has mastered elementary algebra and geometry; and "*projective geometry*" which treats not so much the figures but their projections. The subject, however, is extremely interesting and helpful and throws much light on the elementary field. *Non-Euclidean* geometry builds up a system based on other views of the properties of parallel lines than that in the Euclidean. It usually rejects the Euclidean assumption that parallel lines never meet, and is complex.

ENGLAND'S GEORGES *and the House of Hanover*

Rise of Cabinet Government under the First Two Georges—Injuries Wrought by the Stupid Stubbornness of George III—Change of the Family Name by George V

GEORGE, Kings of England. It was the marriage of the daughter of James I of England to Frederick, Count Palatine of the Rhine (*see* Thirty Years' War), that eventually brought to the British throne the Hanoverian or Guelf (Guelph) line of rulers, five of whom have borne the name of George.

GEORGE I
First of the Hanoverians

George I, a grandchild of this marriage, was Elector of Hanover, a north German state, and succeeded to the British throne as the nearest Protestant heir on the death of Queen Anne. He ruled Great Britain, in addition to his German state, from 1714 to 1727, dividing his time between the two countries. He was a silent awkward man, 55 years of age when he came to the English throne, and spoke only German. Because of this and of his paramount interest in his German lands, he left almost everything to his English ministers, in whom he had implicit confidence. He gradually ceased even to attend cabinet meetings. Sir Robert Walpole, the head of the cabinet and the first real prime minister, became in effect the actual ruler of Great Britain so long as he was supported by Parliament (*see* Cabinet). Adherents of the Jacobite (exiled Stuart) line were easily put down in 1715.

GEORGE II
Under Him Cabinet Government Prevailed.

George's wife, Sophia Dorothea, was divorced for misconduct in 1694, and kept in seclusion until her death in 1726. With this ruler began the habit of bad relations between the king and his heir, the Prince of Wales, which lasted through the 18th century.

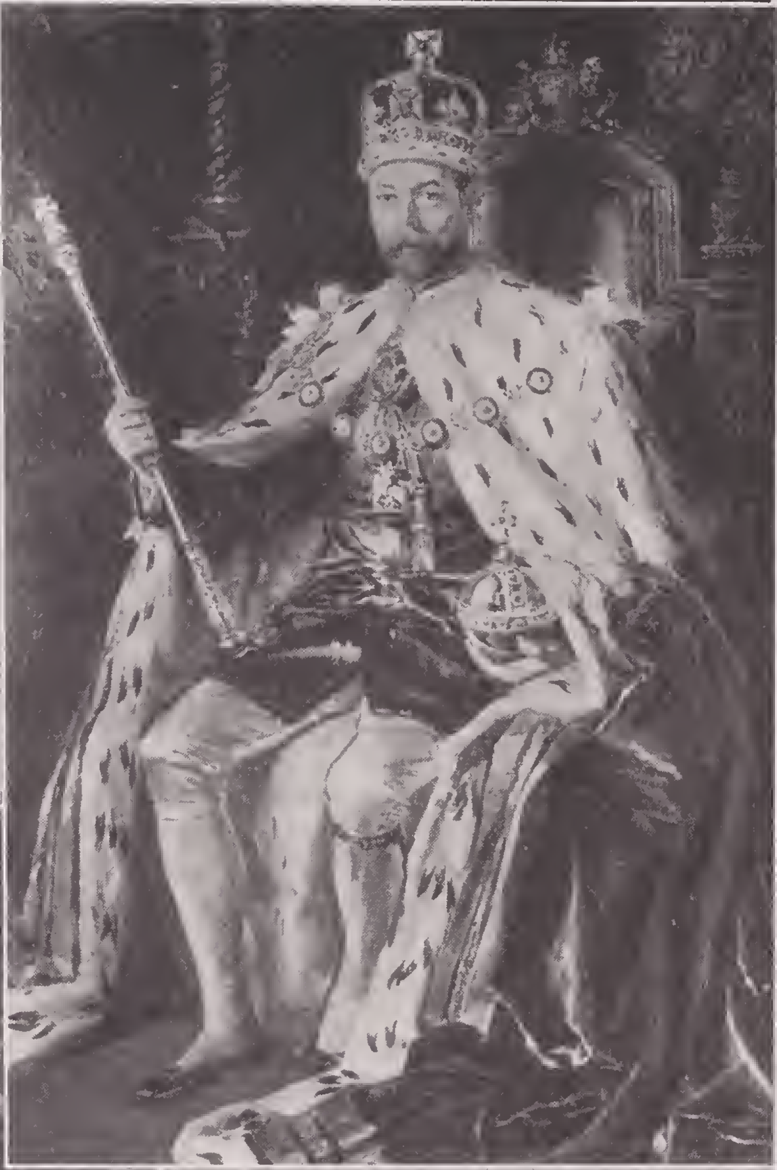
George II, 1727–1760, the son of George I, was, like his father, more interested in Hanover than in England. He was a vain pompous little man, fond of show but extremely economical. One of his favorite diversions, it is said, was counting his money like the king in the nursery rhyme. Although George II spoke English brokenly he too left the management of affairs first to Walpole and later to the elder William Pitt, under whom the country gained brilliant victories in the French and Indian War (*see* Chatham, William Pitt, Earl of). The Jacobite rising of 1745 was a much more serious affair than in 1714, but it too proved unsuccessful (*see* Pretender). George's queen, Caroline of Anspach, was a woman of remarkable ability and proved a tower of strength both to her weak husband and to his English ministers.

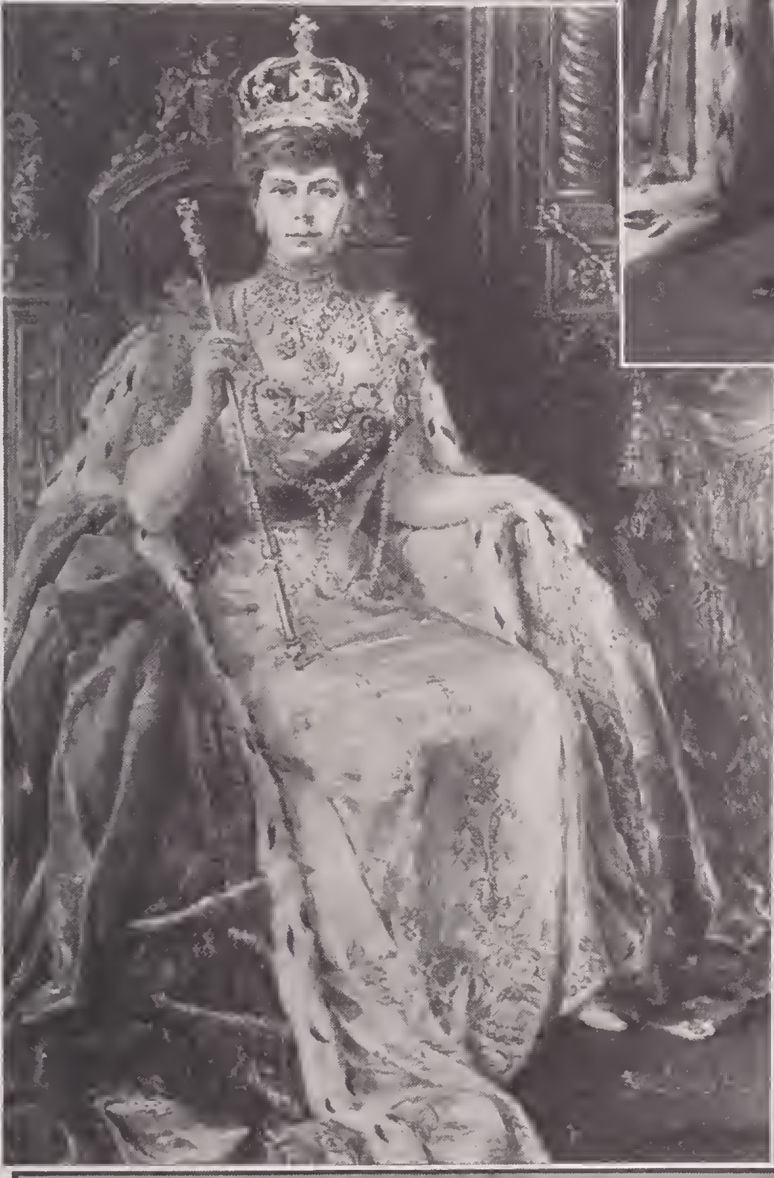
George III, who reigned from 1760 to 1820, was the grandson of George II, born in 1738. His father, Frederick, Prince of Wales, had been on the worst possible terms with George II, but had died in 1751. George III was the first of the Hanoverian rulers who was born and educated in Britain. From his teachers, especially the Scottish Earl of Bute, and from his mother—who continually urged him, "George, be king"—George III drew the idea of restoring the king of England to his old position of power.

GEORGE III
He Caused the Revolt of the American Colonies.

But this could have been done only by a strong king, and George III had only average ability. He had, however, more than average obstinacy, and he refused to give up his course until he lost for England her 13 American colonies and "inflicted more profound and enduring injuries upon his country than any other modern English king." Lecky, the British historian

This is George V, "by the Grace of God of the United Kingdom of Great Britain and Ireland and of the British Dominions beyond the Seas King, Defender of the Faith, Emperor of India." He is shown here in the royal robes and crown of the British Empire, with scepter and orb. Between the state occasions on which this royal regalia is used, it is carefully preserved in the Tower of London.





Queen Mary, formerly Princess Victoria Mary, daughter of Francis, Duke of Teck. The coronation robes in which she is shown were the pride of Great Britain, for every article was the product of British workmanship. The crown, which was made for the occasion, bears the famous Kohinoor diamond, seen in the picture as a dark spot in the center of the crown.

just quoted, further says that George III spent his long reign—longer than that of any other British ruler except Queen Victoria—in "obstinately resisting measures which are now almost universally admitted to have been good, and in supporting measures which are as universally admitted to have been bad." He did not dare to attempt to rule without Parliament as the Stuarts had done, but he sought to corrupt it—by gifts of offices, titles, contracts, and even money—and so built up a party known as "the king's friends." With the triumph of the colonists at Yorktown and the fall of Lord North, the king's figure-head minister, George's attempt at political reaction was ended. First the Whigs and then—after the outbreak of the French Revolution—Willliam Pitt the Younger controlled the government.

George III had long been subject to fits of insanity, and during the last ten years of his reign he was a blind and insane wreck, an object of pity to all. His personal life, as a son, father, and husband, was exemplary.

A Contemptible King

George IV, 1820–1830, the son of George III (born in 1762), was a dissolute and incompetent ruler, though he prided himself on being "the first gentleman of Europe." For nine years before his accession he had been Prince Regent owing to his father's insanity. More wicked kings have reigned over England but none who were more contemptible. His treatment of his young queen was abominable, and when he attempted to divorce her a wave of indignation swept over the land. The government, both in Great Britain and Hanover, was in the hands of his ministers. His brother, William IV, succeeded him in 1830, the only child of George IV (a daughter) having died some time previously. William IV in turn was succeeded by his niece Victoria, daughter of his younger brother, the Duke of Kent (*see* Victoria).

A Wise and Careful Monarch

George V (born 1865, ruled 1910–) was the grandson of Queen Victoria, and son of Edward VII. As a young man he was trained for the sea and had risen to be a commander in the British navy when the death of his elder brother opened to him, at the age of 27, the eventual succession to the throne. As king he sought to maintain the wise policies of constitutional rule followed by his father and grandmother. Like his father he had gained personal knowledge of the outlying posts of the empire by a tour of the colonies before he became king. During the World War he crossed over to France several times and was the first British king since 1743 to join his armies in the field. Owing to the dislike of all things German created by the war, George V announced that henceforth his family would be known as the house of Windsor, from the royal castle of that name in England. The connection of the English royal house with Hanover had ceased in 1837, when a woman, Queen Victoria, came to the British throne.

George, Saint. The most popular of the many legends of St. George, the patron saint of England, is that which tells how he once slew a monstrous dragon, against which an armed force had been of no avail (*see* Dragon). This story, the scene of which is laid at Lydda, an ancient town in Palestine, is of course, pure myth, like most similar legends of heroes in other lands. St. George is said to have been a soldier born of noble Christian parents, in Cappadocia, a Roman province of Asia Minor. He is reported to have suffered martyrdom at the hands of the pagan emperor Diocletian, in the year 303. Many miracles were ascribed to him. He was made the patron saint of England in the reign of Edward III.

George Junior Republic. Near Freeville, N.Y., is a model village whose population is made up entirely of boys and girls from 12 to 18 years old, supervised by a few older persons. The young people enjoy complete self-government, with a constitution, a congress, courts of law, a police force, and a jail of their own. They carry on their own trades and industries, administer all their business affairs, elect their own officers, and make their own laws, subject only to the veto of the superintendent, William R. George, who founded the republic in 1895. It started as a summer colony for poor and wayward children, but soon became a permanent institution where the "citizens" remain for several years. The object is to teach self-reliance, regard for the rights of others, and an appreciation of the many duties and difficulties to be encountered in later life.

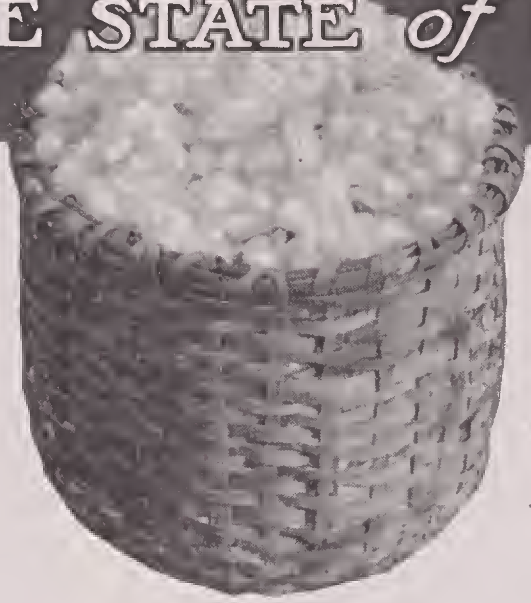
Opportunities are given to every boy and girl to earn money. "Nothing without labor" is the motto of the community, and those who, through laziness or extravagance, find themselves penniless must sleep in the jail and work the next day for the use of the cell and for their meals. The citizens live in group cottages, each under the care of a house-mother. Children under 15 are in charge of a citizen guardian.

All under 16 must go to school. After that age they may continue the higher courses, which prepare them for college, or they may enter business. The boys take up carpentry, farming, plumbing, printing, baking, and other useful trades. The girls are taught sewing, cooking, laundry work, and other branches of domestic science.

The village, which is situated in a 240-acre tract of land, has its school-house, its bank, general store, library, government building, restaurants, and many workshops. Model gardens and small patches of farm lands on the outskirts provide agricultural training. Children from all parts of the United States are admitted, provided they are healthy and in need of the reforming or uplifting influence given by the republic. The religious life is conducted on a non-sectarian basis.

Similar organizations have been founded in a number of other places. In 1908 the National Association of Junior Republics was formed, with Mr. George as director.

The EMPIRE STATE *of the* SOUTH



GEORGIA, STATE OF. Greatest in area of all the states east of the Mississippi; with a surface nearly as large as all New England, Georgia stands in the front rank among the states of the Union as regards the value and variety of its products. More than two-thirds of its area is covered with forests; yet it ranks among the first six states in the value of its agricultural products. Cereals of the temperate zone as well as fruits of the semi-tropics are produced within its borders. It is surpassed only by Texas in the value of its cotton, and corn is a staple crop. Rich quarries add to its wealth, and magnificent water-power helps to convert its cotton and lumber into manufactured articles, making it the "Empire State of the South" as New York is of the North. Emerging from the Civil War with most of its flourishing cities in ruins and its lands devastated, Georgia has been enabled by its great natural resources to advance rapidly to an important position in wealth and industry.

Extent.—North to south, 320 miles; east to west, 253 miles. Area, 59,265 square miles. Population (1920 census), 2,895,832.
Physical Features.—Blue Ridge, Cohutta, Lookout, and Sand Ranges in the northern section (highest point, Brasstown Bald Mt., 4,768 feet); Piedmont region, 300 to 1,500 feet; coastal plain fringed with marshes and islands along the Atlantic coast. Principal rivers, Savannah, Ogeechee, Altamaha, St. Marys, Flint, Chattahoochee; Okefinokee Swamp.
Products.—Cotton, corn, sweet potatoes, hay, oats, sugar cane, peanuts, fruit, and rice; cotton goods, hosiery and knit goods, lumber and timber products, turpentine and rosin, cotton-seed oil and cake, fertilizers; marble and granite, clay products.
Cities.—Atlanta (capital, 200,000), Savannah (85,000), Macon (55,000), Augusta (55,000), Columbus (32,000).

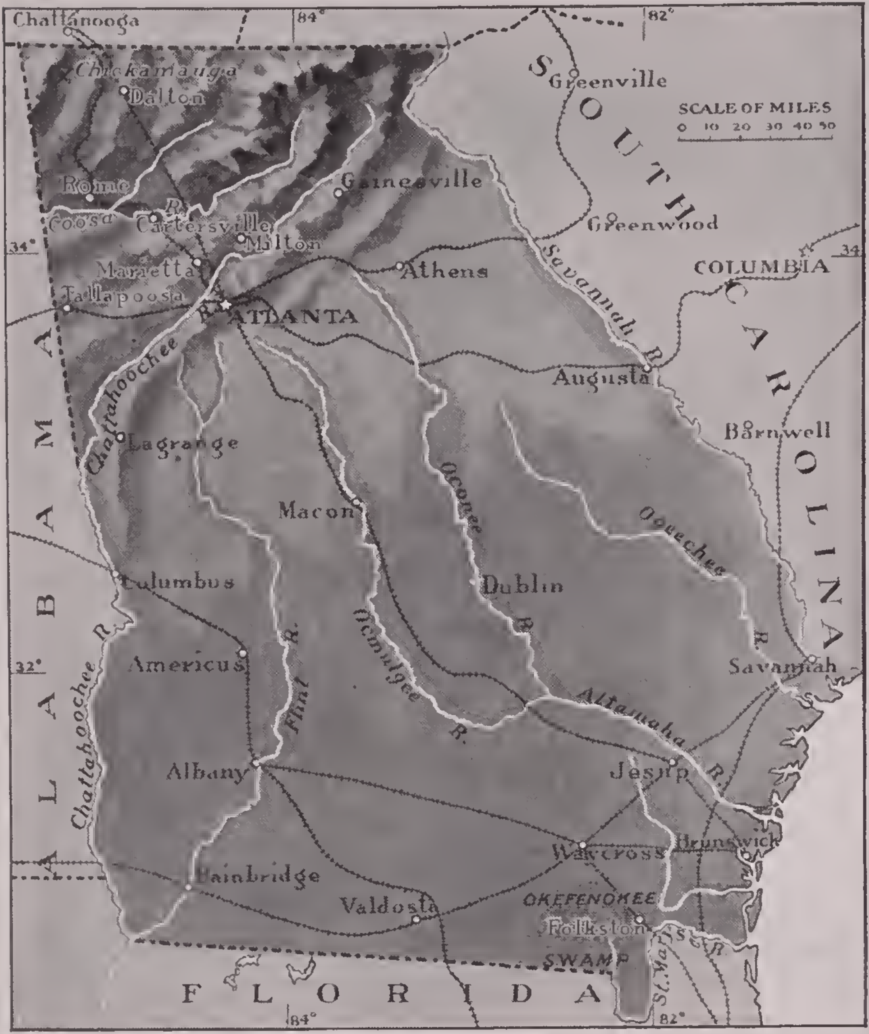
Sloping gradually from the north to the southeast, Georgia is divided naturally into three sections—the northern Appalachian region, the central Piedmont plateau, and the low coastal plain. The first and smallest of these, the "roof garden" of the state, abounds in impressive scenes—waterfalls, cascades, and winding streams, with backgrounds of mountain or hill covered with beautiful forests. Interesting caves are found in many places, some—for example, Hardin's cave near Kingston—of great extent with far-reaching galleries. The northern section is noted also for its charming valleys, which in season are covered with abundant crops of varied cereals, grasses, and fruits.

To the south the Appalachian region gradually gives away to the Piedmont plateau, a level rolling country with only here and there a conspicuous isolated hill. Stone Mountain, near Atlanta, a massive dome of granite over a mile in diameter and 700 feet high, is one of the impressive sights of the state. In this middle section is the densest population, since it has not only the largest proportion of land under cultivation—growing great quantities of cotton, as well as other crops—but the most important cities as well. Dividing it from the coastal plain region is the "fall line," so called because most of the rivers which cross it have rapids at this point. Along this line cities have sprung up on account of the water-power, and also because the fall line marks in most cases the head of river navigation. By drawing a line through Columbus, Macon, Milledgeville, and Augusta, the fall line may be located.

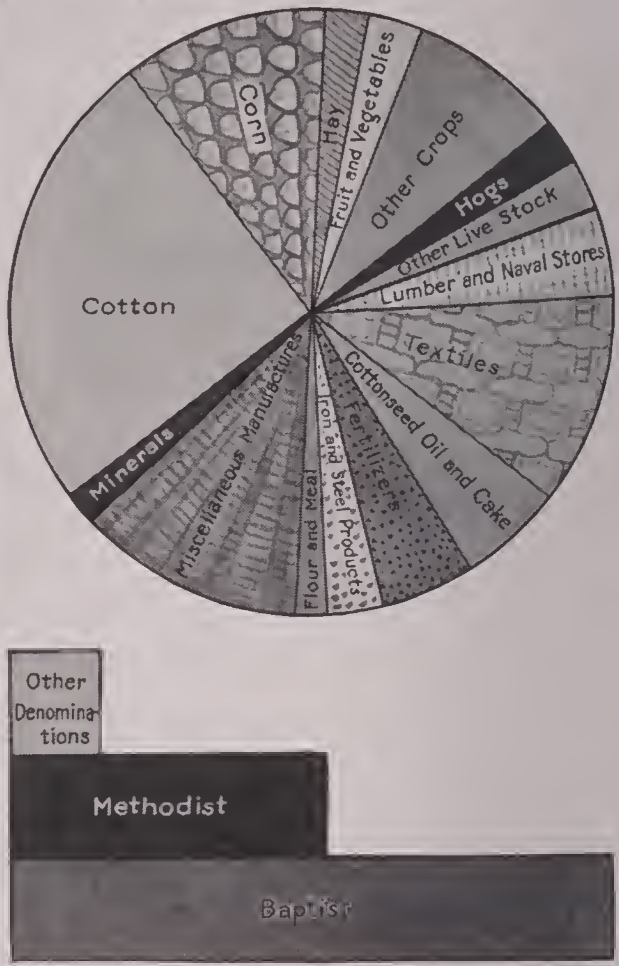
South of the Piedmont region lies the flat coastal plain, covering more than one-half the state, and abounding in large navigable rivers. This section is the region of the sandy "pine barrens," the chief home of the famous Georgia pine; but it is an important agricultural area as well, for in wide belts the forest lands, when cleared and fertilized with the native marls and swamp muck, become excellent farm lands. In the southeast, extending into Florida, is the beautiful wilderness known as Okefinokee Swamp, covering about 700 square miles. Here are found quantities of long-leaf pine, cypress, and saw palmetto, as well as black gum, tupelo gum, and some live oak. The region has long been a favorite resort with sportsmen because of its variety of birds, fish, and game.

Georgia's greatest wealth-producing factor is cotton, which grows in almost every section of the state, from the valleys in the north to the numerous islands along the coast, where more of the famous sea-island cotton is produced than in any other state. Corn, which ranks next to cotton in importance, is also grown practically everywhere. Fruit abounds in all sections, and includes almost every kind grown in the United States; best known, however, are the peaches, watermelons, and cantelopes, which are grown for the northern markets. Sugar cane, used largely in the manufacture of syrup, is grown over the middle and southern sections. The pecan tree thrives near the coast, and peanuts ("goobers") form a very important crop in many counties. Oats and hay are grown in increasing quantities, and grazing is a profitable industry. Rice, long one of Georgia's principal products, is losing importance.

THE STATE THAT IS FAMOUS FOR COTTON, CORN, AND PINE



The circle shows how the products of its fields and forests enrich the state of Georgia, and below we see how the state is divided into religious denominations.



Georgia's vast forests, which still cover approximately 40,000 square miles, rank next after corn as a source of wealth. No tree in the temperate zone serves better the wants of mankind than does the Georgia pine, which can be utilized from its roots to its needle-like leaves. Its long slender trunk is good for furniture and building; the highest grades of charcoal are made from its bark; both roots and bark are used for lampblack; from the sawdust is distilled wood alcohol and creosote; the sap supplies turpentine and rosin; and the seed is used as food for hogs. The hardwoods found in the northern part of the state are also very valuable.

Georgia is not rich in mineral products, although some gold is mined, and coal, iron, and bauxite (aluminum ore) are found in commercial quantities. The state is noted for the excellent quality of its marble, which is exceptionally pure and white. Granite is found in inexhaustible quantities, and clay for brick and tile exists throughout the state.

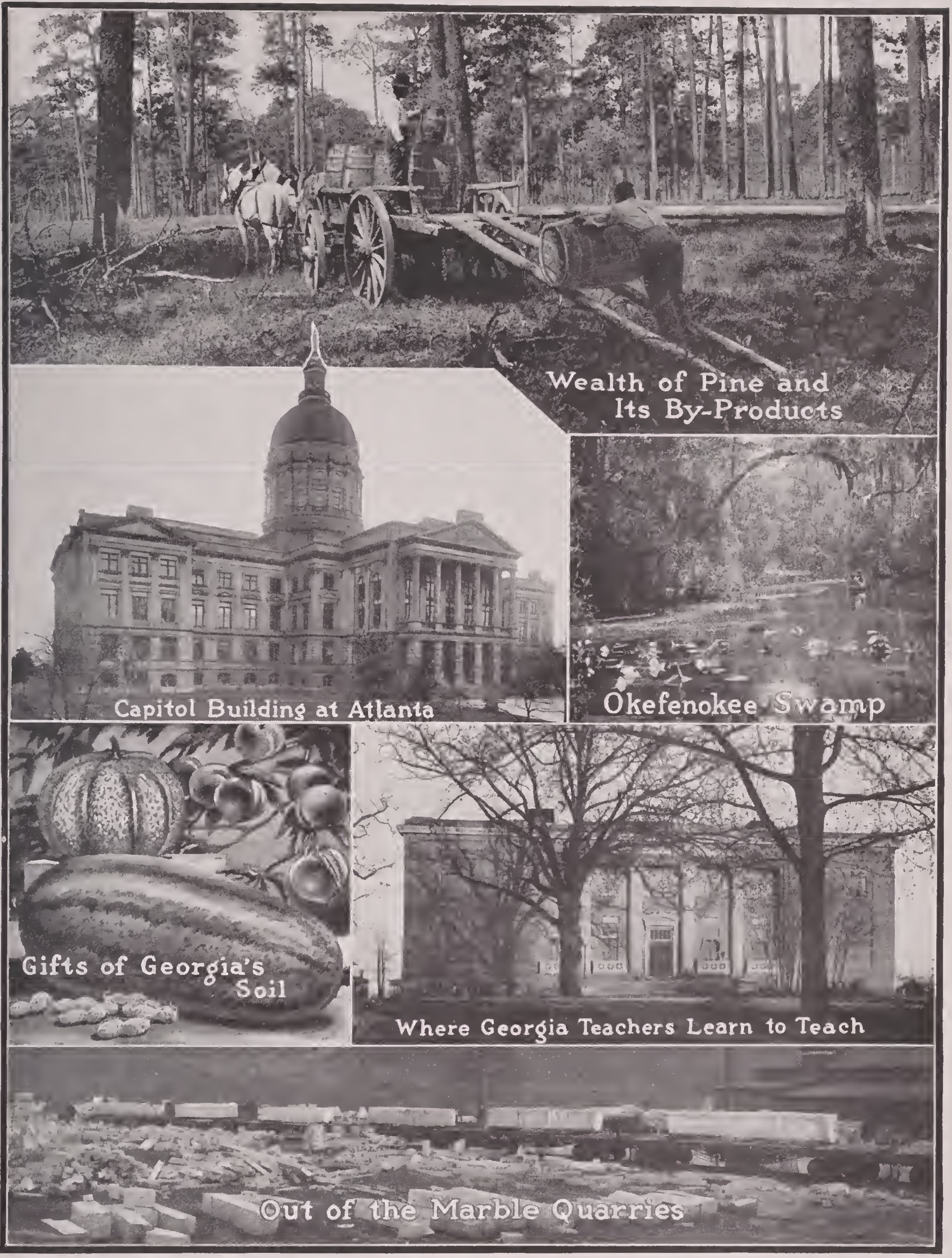
As is to be expected, cotton and lumber form the basis of Georgia's manufacturing industry. Every important city has its textile and cotton-oil mills, and Georgia ranks second among the states in the manufacture of naval stores (rosin, tar, turpentine, etc.). In addition to many furniture factories and lumber mills, there are flour and grist mills, foundries, and manufactories of brick, tile, and pottery.

Only 20 per cent of Georgia's population is urban, but it nevertheless contains some of the most important cities of the South. Savannah, near the mouth of the Savannah River, is the greatest cotton port on the Atlantic coast, and one of the most important commercial cities of the South (*see* Savannah). About 200 miles farther up the river is Augusta, a popular winter resort, which is known as the "Lowell of the South" because it is the largest cotton-manufacturing center of the Southern states. Macon, in the center of the state, is remembered as the home of Sidney Lanier, one of the most lyrical of Southern poets; and also as the seat of Wesleyan College, one of the first of women's colleges. Excellent water-power is furnished for its cotton and knitting mills by a great dam on the Ocmulgee River. The capital and largest city is Atlanta, in the north-central part of the state (*see* Atlanta).

One-half of the total population is made up of negroes, about one-tenth of all the negroes in the country—more than in any other state—residing in Georgia. There is an excellent public school system, but the percentage of illiteracy, especially among the negroes, is high. There are also numerous colleges and industrial schools, some of which are for negroes. The University of Georgia at Athens, the Georgia School of Technology at Atlanta, and the North Georgia Agricultural College at Dahlonega are among the most important higher institutions.

As early as 1540 De Soto and his followers crossed Georgia in their search of gold, but it was more than two centuries before the first European settlement

GLIMPSES INTO THE HEART OF GEORGIA



Wealth of Pine and Its By-Products

Capitol Building at Atlanta

Okefenokee Swamp

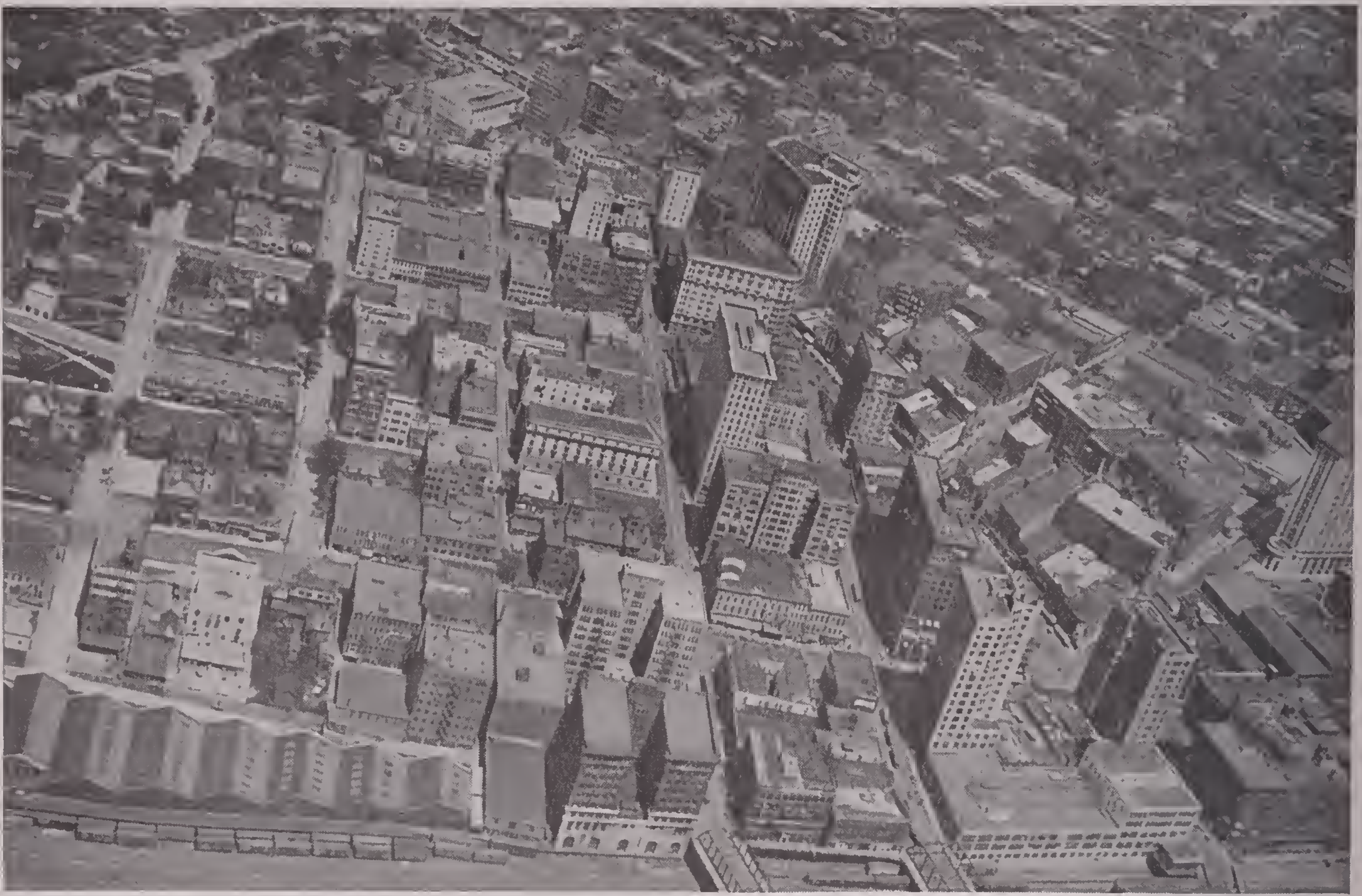
Gifts of Georgia's Soil

Where Georgia Teachers Learn to Teach

Out of the Marble Quarries

Georgia is rich in natural products. Her pine forests are famous the world over, and her rich soil produces typical warm climate crops and such fruits as peaches and melons in abundance, to say nothing of the valuable annual yield of peanuts. Fine grades of marble come from her quarries, and she has large cotton and lumber mills. The scenery of the state is marked by rich vegetation, and her swamp lands teem with varied animal life. Georgia is proud too of the educational advantages afforded by her many institutions of learning. At their head is the State University at Athens, one of whose buildings is shown above.

GEORGIA'S CAPITAL CITY SEEN FROM AN AIRPLANE



This interesting view was taken by an airman flying westward over the principal business district in Atlanta. In the lower left-hand corner is the railway station, while Peachtree Street, the best-known "down-town" thoroughfare, starts in the lower right-hand corner and runs toward the tall building in the upper center.

was made, Georgia being the last settled of the original 13 British colonies. In 1732 a number of benevolent gentlemen in London obtained from the king a charter to found a colony for the poor of Great Britain and the persecuted Protestants of Europe. They called the colony "Georgia" in honor of George II. In 1733 James Oglethorpe, who had been selected as governor, sailed up the Savannah River with 116 immigrants and founded the city of Savannah, which he named after the river. During the ten years of Oglethorpe's administration the colony prospered greatly, and many settlers were attracted to it, including, in 1734, a band of Lutheran refugees from Germany, the "Salzburgers." Slavery was at first prohibited, but allowed after 1749.

A Battleground in the Revolution

Some of the most important battles of the Revolution were fought on Georgia's soil. Under the Federal Constitution the state increased steadily in wealth and population, many settlers coming in from the states farther north. In 1802 Georgia sold to the Federal government all of its lands westward from the Chattahoochee to the Mississippi, and the United States government promised to settle peaceably all Indian claims to territory in the state of Georgia. In fulfillment of this promise it finally transferred all of the troublesome Creeks and Cherokee Indians to their alloted lands in Indian Territory.

In 1861 Georgia seceded from the Union, and it bore a prominent part in the Civil War which followed. Chickamauga and other great battles were fought within its borders, and Sherman's march "from Atlanta to the sea" scattered destruction along its path. Reconstruction was begun immediately after the declaration of peace, and Georgia gradually regained its important position of pre-war days. In restoring good feeling between the North and South, one of the most prominent workers was Henry W. Grady, a silver-tongued orator and journalist of Atlanta, who labored untiringly for the advancement of the "New South."

GEORGIA. A democratic republic of Asia, south of the Caucasus Mountains and bordering on the Black Sea to the west. It was formerly a part of Transcaucasian Russia, but declared its independence (May 26, 1918) following the Russian Revolution. Tiflis is the capital and Batum the chief port. The people are a handsome athletic race of ancient white stock (*see* Caucasus Mountains). In spite of long pressure from surrounding Mohammedans, they are devoted members of the Greek Catholic church. From the time of Alexander the Great to the Conquest of Russia (1801) Georgia had its independent line of princes. Cereals, cotton, fruit, and wine are the chief products of the country. Area, about 35,000 square miles (about the size of Indiana); population, 2,700,000.

GERANIUM. Botanists tell us that the red, white, or pink "geranium" plants whose spicy fragrance scents summer gardens and window-sills really are not geraniums at all; they are pelargoniums. But real geraniums are found all over our woods and thickets—graceful wild flowers that often look like wild roses, swinging their five-petaled heads on long hairy stems. We call them crane's-bills or wild geraniums. The spotted crane's-bill is about two feet high and each of its numerous branches bears two light purple flowers about an inch across. Its bitter root-stock is used as a medicine. Another common species is Herb Robert, a plant with dainty little light purple flowers streaked with red, found in damp shady woods and ravines.

The house plants we call "geraniums"—the pelargoniums—belong to the same family but differ greatly from the true geranium in appearance. They are much prized for their large, irregular, variously colored flowers and their leaves that vary so in shape, texture, and marking. Geranium oil, a substitute for attar of roses, is distilled from certain species growing in Algeria and in Cape of Good Hope, where most of the plants of this genus have come from.

Both the geranium and the pelargonium belong to the plant family *Geraniaceae.* The geraniums number about 160 species, and are dispersed throughout the temperate regions of the world. The pelargoniums—the commonest of whose 200 species are the cultivated ivy geranium (*Pelargonium peltatum*), the rose geranium (*Pelargonium graveolens*), and the nutmeg geranium (*Pelargonium odoratissimum*)—are perennial herbs or shrubs.

The Language of LUTHER, GOETHE, *and* SCHILLER

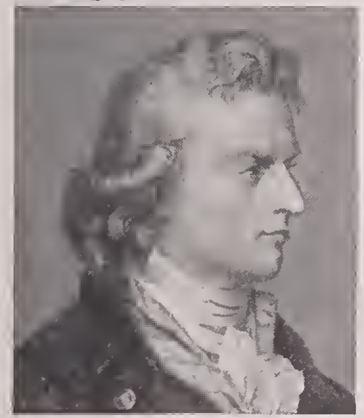
GERMAN LANGUAGE AND LITERATURE. Rough and guttural though German may be, it somehow lends itself naturally to poetry. While German prose is often inclined to do anything but come "trippingly on the tongue," the best German verses are true music. They are alive with sincerity, they speak directly and unmistakably to the human soul, they strike deep to the very elements of life. And much of this wild-flower charm is apparently due to the vital quality of the language itself.

MARTIN LUTHER

His Translation of the Bible Fixed the Standard of German Prose.

When we first meet with the Germans, or Teutons, about the beginning of the Christian era, they form three distinct groups with corresponding tongues—the East Germanic or Gothic, the North Germanic or Scandinavian, and the West Germanic, from which originated primitive German, English, Dutch, etc. This primitive German continued to split up into dialects as the tribes settled permanently in various districts; but the chief dialects were the High German of the mountainous region of central and southern Germany, and the Low German of the lowland country in the north. High German won out over the dialect of the plains, and it is High German which is the official and literary language of Germany today.

SCHILLER



Lyric Poet, Dramatist, and Friend of Freedom.

German is really a simple and direct language, although it may present a formidable appearance to the beginner. The first difficulty lies in the old "Gothic" characters, in which most German books are printed. This alphabet is simply a variation of the Roman, and any word written in the former can be reproduced letter for letter in the latter script. Next, the beginner is struck by the enormous length of many German words. But these are due to the ease with which compounds are formed, and when such words are split up into their several parts, they prove not only easy to understand but have a remarkable gift of expression. Thus, the word "Volksschullehrerseminar" looks almost hopeless with its 23 letters, until we divide it thus: "Volks-schul-lehrer-seminar." Then we discover by translating it bit by bit that it means "public-school-teachers' seminary," or, in other words, a training college for elementary teachers.

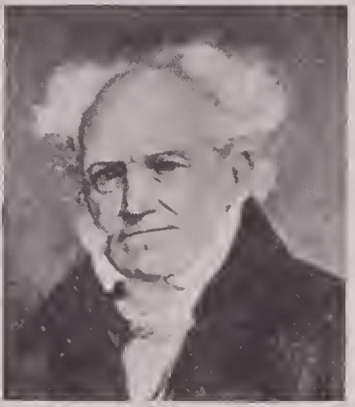
The formation of such compounds gives an exactness of meaning which is often lost in looser English phrases. And when we add to this the practice, so common in German syntax, of reserving the verb or part of the verb for the end of the sentence, thus holding the reader's attention suspended until the *whole* of the thought has been expressed, we realize why German is so valuable a language for scientific descriptions of all sorts.

HEINE

A Sparkling Poet and Master of Wit and Irony.

The Roman historian Tacitus, writing in the year 98 A.D., tells us that already the German barbarians of that period had a poetry of their own. The warriors would advance to battle, he says, singing hymns to Thor, the god of thunder, their shields held before their mouths to clang out a greater volume of sound. And ever since, no matter what refinements or complexities have developed in German literature, there still remains in it this martial clang of shields, the distant thunder of tribal religion, a hard sonorous music, larger and louder than life. Even the sweetest of their folksongs have something at once vigorous and dark running through them.

SCHOPENHAUER



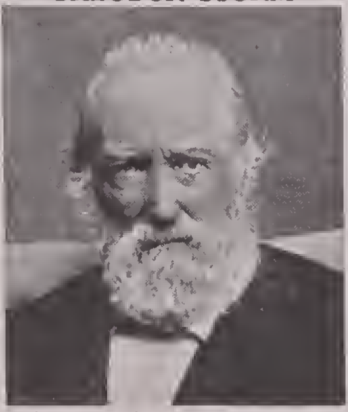
A Philosopher who Preached a Doctrine of Pessimism.

For a long time this ancient poetry remained unwritten, or, if fragments of it were carved now and then in the old Runic alphabet on wooden staffs and metal tablets, it was soon lost, or at best remained but fragments.

Not until the 4th century do we find a book written in a Teutonic tongue, and by that time it treated not of the god Thor, but of Christianity. This book was a translation of the Bible made by Ulfilas, the native missionary to the Goths. In order to make his translation, Ulfilas was obliged first to invent the Gothic alphabet, combining Greek, Latin, and Runic letters to do so. The tongue of those ancient Goths, as we here find it, possessed much of the rolling beauty and expressive roughness of the German language today.

But though Ulfilas began the conversion of the Germans to the Christian religion, their poets continued for centuries to sing of the old gods, of Brunhild and Gudrun, and the flying Valkyrs, as well as of mighty historic figures such as Attila (Etzel) the Hun. The 'Nibelungenlied' of the 13th century is the most famous of these wild old dreams of gods and heroes, and it has been the source of much modern German literature, like a great changeless lake of rugged beauty from which trickle delicate but more transient streams.

THEODOR STORM



Author of the Prose Idyl 'Immensee'.

A lighter note, however, tinkled along beside these resounding epics, the music of the "minnesongs," or love lyrics of knighthood. These dwindled out finally in the wholly mechanical "mastersongs," composed by rule and turned out like factory goods. Yet the same period (15th and 16th centuries) in which these stiff and dreary mastersongs were being manufactured was the very heydey of the delightful German "folksongs"—simple abiding music, by poets whose names are unknown.

About this time also German prose began to develop and also German drama, chiefly in the hands of the clergy. Church plays grew into great and solemn spectacles, of which the celebrated Passion Play of Oberammergau is an impressive survival. And when the Reformation came in the church, religion found even more beautiful expression in the fine old hymns of Martin Luther. But it was Luther's translation of the Bible which had the most important effect. This did for the German language what the works of Dante, Petrarch, and Boccaccio did for Italian, or what the King James Bible did for English. It fixed the standard of the language in the midst of a confusion of dialects. Modern German dates largely from Luther's works.

As the years went on, religious disputes became angrier; the Thirty Years' War (1618–1648) broke out, and the light of literature vanished in its horrors. National feeling decayed, and a weak and war-worn generation mimicked French thought and customs in almost every field. Great literature does not come by imitation.

Therefore it was not until the time of Frederick the Great that German literature flourished again. To be sure, this king of Prussia was contemptuous enough of the national literature; he preferred to copy the French style of writing and honored French authors, notably Voltaire, far more than he did the oncoming German writers. But Frederick raised Germany from the dust, and gave to German genius a sense of pride and independence which permitted it to break with French and English models—in spite of Frederick himself—and create beauty out of its own substance. Thus Frederick's reign (1748–1786) ushered in the "great century of German literature."

In this century glow the names of Klopstock, Lessing, Wieland, Goethe, Schiller, Richter, the brothers Grimm, Fouqué, von Kleist, Heine, and many more. Under the influence of English and French philosophers, such as Locke and Voltaire, whose views Frederick broadly championed, the Germans were prodded into new paths, and new thoughts began to travel in men's minds.

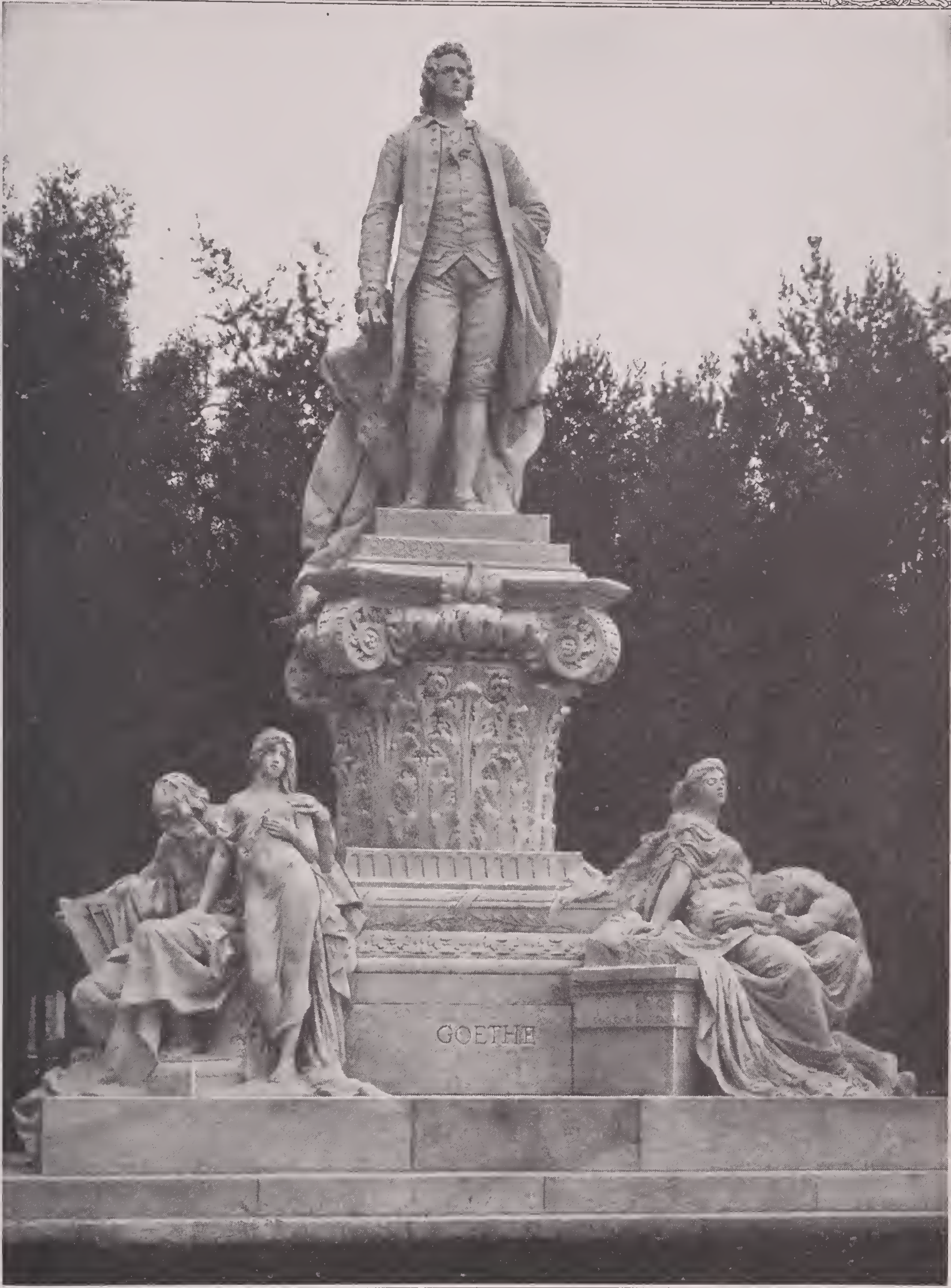
NIETZSCHE

Author of the Famous Doctrine of the "Superman."

To Klopstock goes the honor of molding a new poetic language. Lessing, the first of the great German classic authors, is the master of style, the foremost German critic, who preached the harmony of content and form and banished the long gusty pages of description and high-soaring allegory. Wieland, epic poet and novelist, pioneered the way for free expression of emotion, and edged in a new and neater wit.

Then came the influence of Rousseau, the little Swiss who set France on her fateful way to the Revolution. Aided largely by the work of Herder, this

GOETHE — THE RULING GENIUS OF GERMAN LITERATURE



This striking statue of the great poet, dramatist, and philosopher — Johann Wolfgang Goethe—stands in the gardens of the Borghese Villa in Rome to commemorate Goethe's stay in Italy, during which he absorbed so much of the classic spirit. Physically Goethe recalled the Greek ideal of manly beauty—a powerful and symmetrical frame and features cast in heroic mold. On the mental side the resemblance was no less marked. He seemed instinctively attracted by the calm and majestic beauty of the classical spirit as reflected in literature and art. This feeling grew during his Italian visit and profoundly influenced his later works.

influence produced in Germany what is termed the "storm and stress" movement. People began to talk of the perfect freedom of the individual, and to rebel at tradition and authority. Politically the movement came to nothing in Germany, but in literature the effect was enormous. Writers rejected the classic laws of composition under the impression that they were proceeding in the manner of Shakespeare! The great Goethe, bearer of the brightest name in German literature, shared in the movement, and likewise Schiller, his shining contemporary. The "storm and stress" grew rapidly into the rankest sentimentalism, a sad twilight mood in which it became fashionable to feel one's self misunderstood, and revel in misery.

But presently came the sobering effect of the philosopher, Immanuel Kant, with his stern doctrine of duty, followed by Goethe's swing back toward classicism and order as the result of Italian influences. Thus this balloon of sentiment was punctured. Perhaps the laughing irony of Jean Paul Richter's novels also had something to do with sweeping away the last bits of the "storm and stress."

However, something very similar to the "storm and stress" again developed during the Romantic period which followed. This was partly due to the philosophy of Immanuel von Fichte, who denied Kant's theories, and of Frederick von Schelling, who offered the imagination for as good a guide in life as the intellect. The Romantics were individualists, obscure and capricious; but on the other hand they freed the wings of poetry, unveiled the beauties of folklore, and opened long vistas of foreign thought before the provincial German mind. And above all, from them came Heinrich Heine, the greatest lyric poet since Goethe, master of wit and irony, poet of the sea, artist of exquisite moods and of light crystalline style.

Heine lived in the years of Germany's losing struggle against the rise of absolute monarchy. In 1848 the sword drawn for German freedom was defeated by Prussian absolutism, of which the historian Treitschke was later the apologist and champion. During that period there were great names and there have indeed been many more since—Wagner, the dramatist-musician; Schopenhauer, the brilliant philosopher; Storm, famous for his idyl 'Immensee'; Nietzsche, the apostle of the "superman"; Sudermann and Hauptmann, the dramatists of modern realism. But literature labored under the yoke of commercialism and militarism, weeds almost too strong to permit ideals to flourish in the same soil.

Chief Figures in German Literature

Ulfilas (311–383)—Translation of Bible into Gothic.

Walther von der Vogelweide (1165–1230), minnesinger; national poet of Middle Ages.

Wolfram von Eschenbach (1170–1220), poet of knighthood—'Parzifal'; 'Titurel'.

Martin Luther (1483–1546)—Translation of the Bible; hymns; sermons.

Hans Sachs (1494–1576), mastersinger and dramatist—'Fastnachtsspiele' (Shrovetide Plays).

Friedrich Gottlieb Klopstock (1724–1803), classical poet — 'Der Messias' (The Messiah); odes.

Gotthold Ephraim Lessing (1729–1781) critic and dramatist—'Emilia Galotti'; 'Minna von Barnhelm'; 'Laokoön'.

Christoph Martin Wieland (1733–1813), novelist and poet—'Der goldene Spiegel' (The Golden Mirror); 'Agathon'; 'Oberon'.

Johann Gottfried von Herder (1744–1803), critic—'Kritische Wälder' (Critical Forests); 'Ideen zur Philosophie der Geschichte' (The Philosophy of History).

Johann Wolfgang Goethe (1749–1832), poet, critic, dramatist, and novelist — 'Die Leiden des jungen Werthers'; (The Sorrows of Young Werther); 'Wilhelm Meister'; 'Faust'; 'Tasso'; many lyrics.

Johann Christoph Friedrich Schiller (1759–1805), poet and dramatist — 'Das Lied von der Glocke' (The Song of the Bell); 'Wallenstein'; 'Maria Stuart'; 'Die Jungfrau von Orleans' (The Maid of Orleans); 'Wilhelm Tell'.

Jean Paul Friedrich Richter (1763–1825), humorous novelist—'Quintus Fixlein'; 'Siebenkäs'; 'Flegeljahre' (Wild Oats).

Friedrich de la Motte Fouqué (1777–1843), novelist — 'Undine'; 'Theodolf, The Icelander'.

Heinrich von Kleist (1777–1811), dramatist—'Penthesilea'; 'Der zerbrochene Krug' (The Broken Pitcher).

Jakob (1785–1863) and Wilhelm (1786–1859) Grimm—Fairy Tales.

Arthur Schopenhauer (1788–1860), philosopher — 'Die Welt als Wille und Vorstellung' (The World as Will and Idea).

Heinrich Heine (1797–1856), poet — 'Die Lorelei' and many other poems; 'Reisebilder' (Travel Pictures).

Franz Grillparzer (1791–1872), dramatist — 'Sappho', Das goldene Vliess' (The Golden Fleece).

Hoffman von Fallersleben (1798–1874), poet and song writer—'Deutschland, Deutschland über alles'.

Friedrich Hebbel (1813–1863) dramatist — 'Judith'; 'Herodes und Marianne'; 'Agnes Bernauer';

Otto Ludwig (1813–1865) dramatist and novelist—'Der Erbförster' (The Hereditary Forester); 'Zwischen Himmel und Erde' (Between Heaven and Earth).

Richard Wagner (1813–1883), writer of operas—'Tannhäuser'; 'Lohengrin'; 'Parsifal'; 'Der Ring des Nibelungen' (The Nibelungen Ring).

Gustav Freytag (1816–1895), novelist and dramatist—'Die Journalisten' (The Journalists); 'Soll und Haben' (Debit and Credit).

Theodor Storm (1817–1888), poet, novelist, and short story writer—'Immensee'.

Gottfried Keller (1819–1890), novelist and short story writer—'Der grüne Heinrich' (Green Henry); 'Die Leute von Seldwyla' (Seldwyla Folk).

Paul Heyse (1830–1914), poet, dramatist, novelist, and short story writer — 'L'Arrabiata'; 'Kinder der Welt' (Children of the World); 'Im Paradiese' (In Paradise).

Heinrich von Treitschke (1834–1896), historian—Deutsche Geschichte im neunzehnten Jahrhundert'. (History of Germany in the Nineteenth Century).

Friedrich Nietzsche (1844–1900), philosopher and essayist—'Jenseits von Gut and Böse' (Beyond Good and Evil); 'Also sprach Zarathustra' (So Spake Zarathustra).

Hermann Sudermann (1857–), dramatist and novelist—'Es lebe das Leben' (The Joy of Living); 'Heimat' (translated as Magda); 'Frau Sorge' (Dame Care).

Gerhardt Hauptmann (1862–), dramatist — 'Die Weber' (The Weavers); 'Die versunkene Glocke' (The Sunken Bell); 'Hannele'.

Arthur Schnitzler (1862–), dramatist — 'Anatol'.

Richard Dehmel (1863–), poet and dramatist — 'Michel Michael'; lyric poems.

Frank Wedekind (1864–1918), dramatist — 'Frühlings Erwachen' (The Awakening of Spring).

The GERMAN LAND *and* PEOPLE

Extent.—Area of German Republic, about 180,000 square miles. Population, about 60,000,000. Latitude, 47° 16′ to 55° 53′ N. Climate, continental, with cold winters in northeast, milder in west; Rhine valley, warm summers with brilliant sunshine, suited to wine growing.

Rivers.—Danube, Rhine (Moselle, Neckar, Main, Ruhr, tributaries), Ems, Weser, Elbe (Saale, tributary), Oder, and Vistula.

Mountains.—Bavarian Alps, Bohemian Forest, Erzgebirge ("Ore Mountains"), Sudetes, Black Forest, Thuringian Forest, Taunus, and Harz Mountains.

Products.—Iron and steel manufactures, textiles (cotton, woolen, linen, and silk), beet sugar, chemicals, electrical goods, pottery, wine and beer, etc.; wheat, rye, oats, barley, hops, tobacco, timber, live stock, and dairy products; herring and other fish; coal, iron, lead, copper, potash, etc.

German States.—Prussia, Bavaria, Saxony, Württemberg (former kingdoms); Baden, Hesse, Mecklenburg, Saxe-Weimar, Oldenburg (former grand duchies); Brunswick, Anhalt, Saxe-Coburg-Gotha, etc. (former duchies); Waldeck, Lippe, Reuss, Schwarzburg, etc. (principalities); Hamburg, Bremen, Lübeck (free towns). Total, 25.

Chief Cities.—Berlin (capital, 2,000,000); Hamburg, Munich, Leipzig, Dresden, Cologne, Breslau (over 500,000); Frankfort-on-Main, Düsseldorf, Nuremberg, Charlottenburg, Hanover, Essen, (over 300,000); Chemnitz, Stuttgart, Magdeburg, Bremen, Königsberg, Neu-Kölln, Dortmund, Stettin, Duisberg, Kiel (over 200,000).

This is a peasant's cottage in the Black Forest. The first story, built of stone, probably houses the horses and cows of the family, dwelling comfortably under the same roof with the good thrifty farmer folk. Yet, despite these strange lodgers, the German peasant's home is invariably spotlessly clean and neat, for the German "Hausfrau" is one of the best housekeepers in the world.

GERMANY. Where may one find a land of greater natural resources; of such charming scenic beauty, with the quaintest medievalism alongside the triggest modernity; of more splendid scientific, industrial, and artistic achievement? And where is there a people of more disciplined intelligence, real kindliness, and solid worth, combined in recent years with such hateful and dangerous ideas of militarism, national aggression, and the absolute power of the state? The creation of the German Empire by Bismarck and its amazing growth in prosperity and power was one of the stupendous events of the latter 19th century. Its collapse, through the World War, which it arrogantly began, was as dramatic and complete a downfall as that of ancient Rome or of the empire of Napoleon Bonaparte!

Before the German Empire was shorn by the Paris Peace Conference—west, north, and east—the map of Germany was not unlike the picture of a stupid helmeted giant, sprawling on all-fours, with a pigmy master atop. Prussia made up the body and head, with Berlin at the heart, and its ore and grain-bearing province of Silesia, stolen long ago from Austria, as creeping arms and hands. Schleswig, filched in 1864 from Denmark, pictured the Hohenzollern masters; while the South German states and Alsace-Lorraine formed an undefined but important lower part.

Today the picture is very different, not only in outline but in spirit. Rather is it now a crushed and huddled nation, gaunt with suffering, drawing painful breaths of desperate economic recovery and new political freedom.

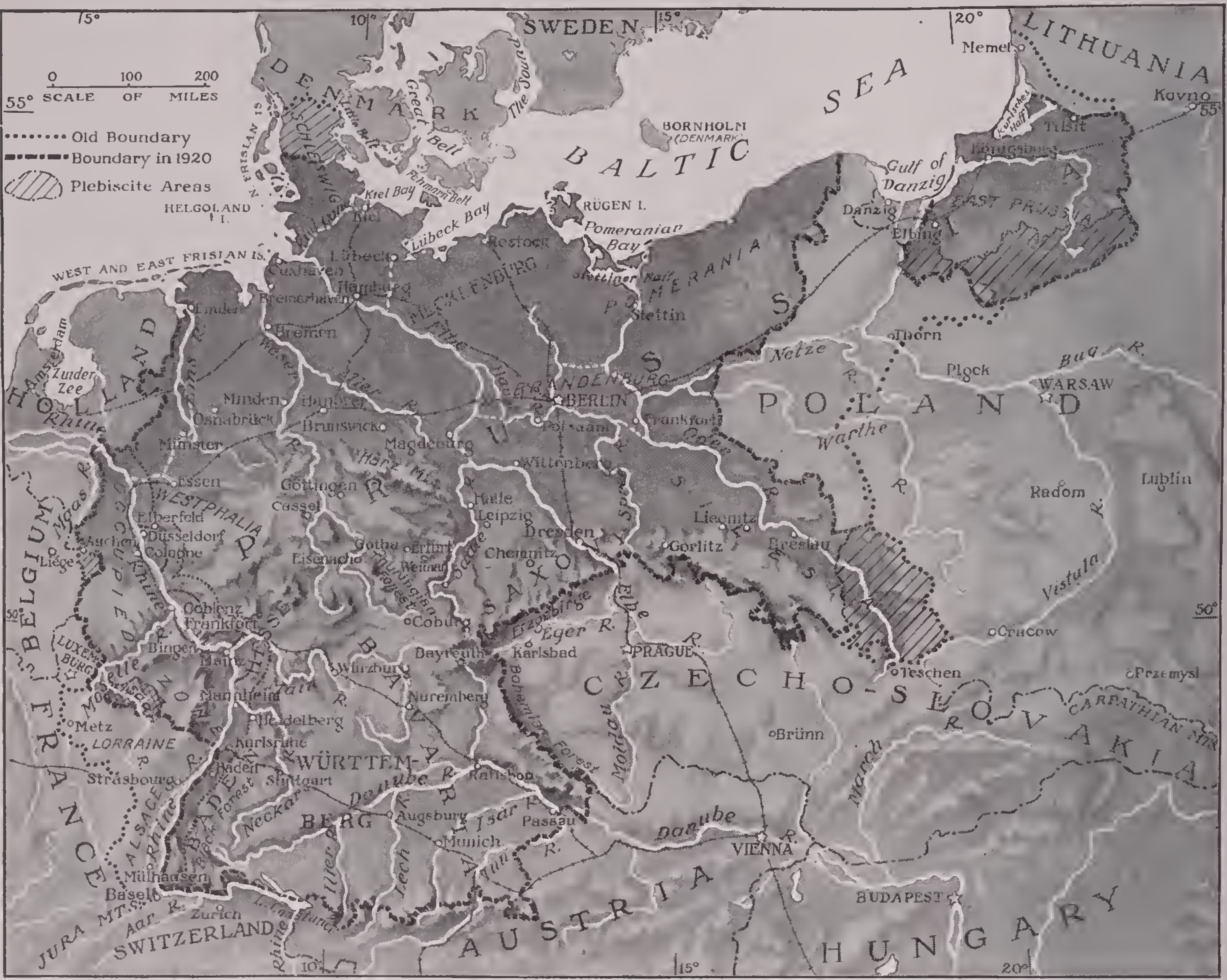
Let us begin our visit to this land by flying swift and high from southwest to northeast—the route to Berlin that the Allied airmen longed to take, but could not. A green and smiling country it lies below us, about the size of Ohio, Indiana, Illinois, and Michigan combined. It stretches from the Alps and the Bohemian mountains northwest to the Baltic and the North Sea, and from Belgium and Luxemburg on the west to the restored republic of Poland on the east.

Like a silvery ribbon the Rhine, the king of German rivers, flows from Switzerland to the sea. It is navigable as far as Basel and is connected by canals with both the Danube and the Rhone, so that commerce from its shores can pass either to the North Sea, the Mediterranean, or the Black Sea. Its falls at Schaffhausen are the largest and most picturesque in Europe. Palatial steamers bear travelers down its stream, past historic cities of the Middle Ages, past bustling seats of modern industry and commerce, to sunny vineyards on terraced hills, and innumerable heights crowned with ruined castles. The middle Rhine and the valley of the Moselle, its chief tributary from the west, produce some of the finest wines in the world. Innumerable legends, folksongs, and romantic tales cluster about this lordly river, the heart of German life and history (*see* Rhine River).

Northern Germany unfolds itself before us as a fairly uniform plain, a part of the great lowland that extends from the vast expanse of Russia to the English Channel. Across it numerous large rivers flow northward—the Ems, Weser, Elbe, Oder, and Vistula—all with large seaports at or near their mouths and navigable for steamboats either entirely across or far into the heart of Germany. An enormous amount of commerce, especially of bulkier goods, is borne on these rivers and the tributaries and 1,500 miles of canals which connect them. The chief of the German rivers are internationalized by the peace treaty so as to enable other nations to use them on equal terms.

The German plain is narrowed in the west by the Thuringian hills and the Harz Mountains (*see* Harz

GERMANY BEFORE AND AFTER THE WORLD WAR



The World War cost Germany about 15 per cent of its European territory, as you can see by following the dotted lines of the old boundary. Under the Peace of Versailles, a portion of East Prussia was given to Lithuania, and the reëstablished state of Poland received parts of Posen, Pomerania, West Prussia and East Prussia, with the nationality of several districts to be determined by plebiscite of the inhabitants. On the west, Alsace-Lorraine was restored to France, a small area went to Belgium after a plebiscite, and that portion of Schleswig-Holstein which expressed its preference for Danish allegiance was restored to Denmark.

Mountains). Like all the mountains of Germany proper, these are old worn-down ranges and are forest-covered. In places, also, low hills parallel the sandy shores of the Baltic. Forests of beech, spruce, and pine, and numerous marshy lakes are found in the east, and near the western coast desolate moors.

The sandy soil and harsh climate of the northern plain are unfavorable to agriculture, but science and patient labor produce on the great estates of Prussia and Pomerania bountiful crops of rye, barley, oats, sugar beets, and potatoes—potatoes by the millions of bushels, for these are the chief food of the German people. Indeed, in one small German town (Offenburg, in the Black Forest) stands a statue erected to Sir Walter Raleigh, as the one who first introduced this important tuber to Europe. Horses, cattle, sheep, and hogs are also raised extensively; while the turf cut from the Lüneburg moorlands supplements the coal and lignite from more favored regions.

In this northern half—the essentially Prussian part of Germany—lies Berlin, the most modern of European capitals. No American city can present a more amazing example of growth, and none anywhere such cheerless and pretentious magnificence (*see* Berlin).

Only three important ports—the quaint Hanseatic town of Lübeck, humdrum Stettin, and Königsberg—remain in the possession of Germany on the Baltic today; for Danzig and Memel are in territory now controlled by the League of Nations. Facing the North Sea, however, are the still thriving maritime cities of Bremen and Hamburg (*see* Bremen, Hamburg). The former naval harbor of Kiel also stands at the Baltic end of the great canal which cuts across the neck of Jutland. Excepting Kiel, all these German maritime cities are river-mouth ports. Shipbuilding and fisheries are among the most important industries in these regions.

Finally we shall notice that this northern plain, owing to its lack of protecting mountain barriers, lies open to easy invasion. Hordes of barbarian Goths, Slavs, and Tatars swept across it in far-off ages. More recently it has been a battle-ground for the

HAMBURG, THE LARGEST SEAPORT IN GERMANY

This picture shows one of the principal waterfront streets of Hamburg, which is the largest and most important of German seaports and was before the war the third largest in the world, ranking next to London and New York. Together with the city of Altona, which is continuous with it, it presents a frontage of six miles on the Elbe River, which leads to the sea 75 miles away. Hamburg also straddles the little river Alster. Handsome shops, great hotels, and fine restaurants face upon the water. Small steamers, such as those shown in the picture, are the favorite means of travel between the business center and the outlying suburbs.

armies of Sweden, Spain, and France in the devastating Thirty Years' War, for the conquering hosts of Napoleon, and the advance and retreat of Austrian and Prussian swarms. In self-defense, therefore, Prussia was compelled to become a military power with movable frontiers, and war and conquest as national industries. The tragedy of Germany was the later conversion of all Germany, including the easy-going, art-loving, philosophic south and west, to the hard Prussian doctrine that "might makes right."

Central and Southern Germany

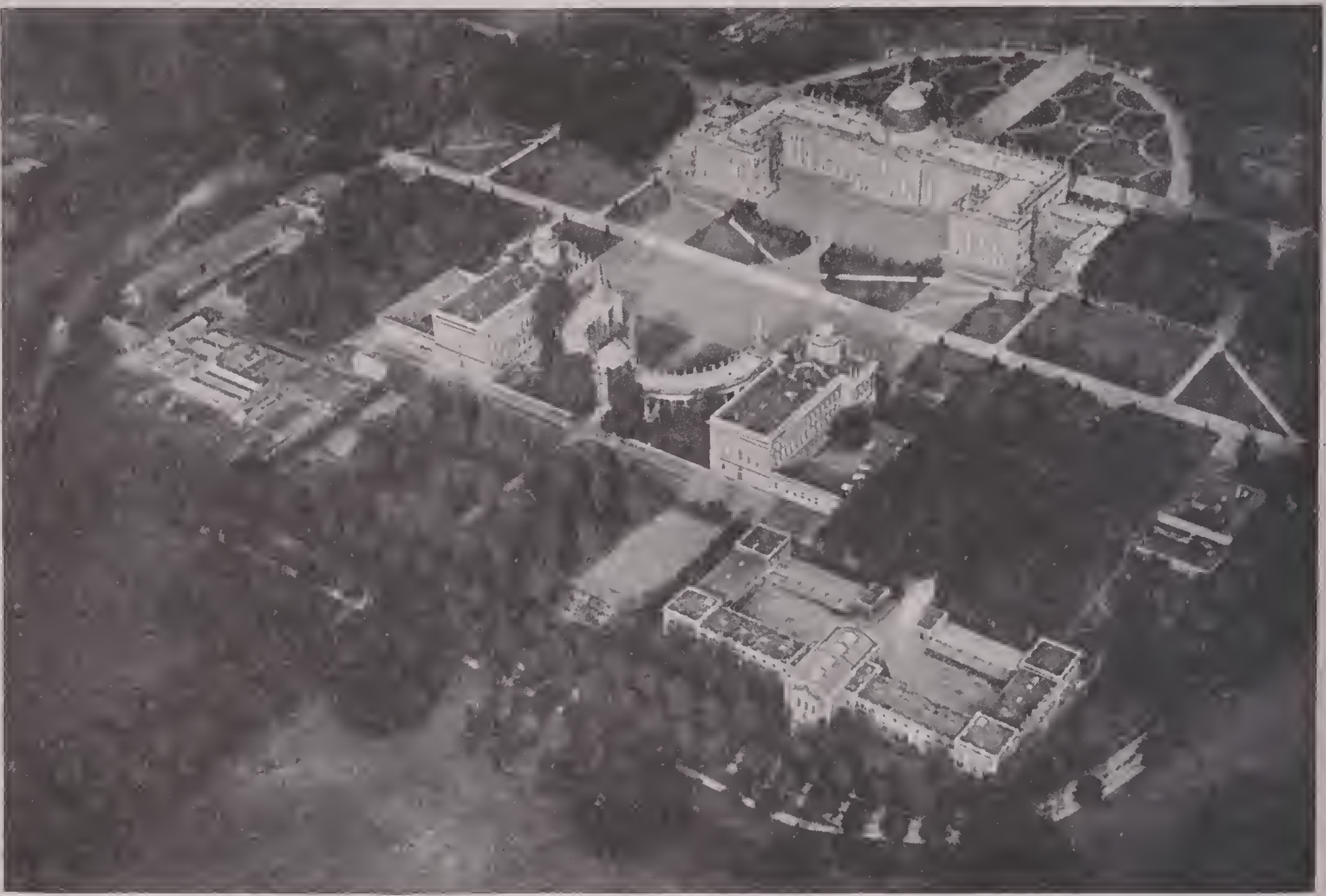
Westward of the mountain-rimmed parallelogram of Bohemia (a Slavic state as large as West Virginia which protrudes into Germany's southern boundary) (*see* Czecho-Slovak Republic) lie the old home-lands of German culture—Bavaria and the regions still sometimes known as Swabia and Franconia. Seven hundred years ago while the original Prussians beyond the Vistula were still heathen Slavs, Franconia and Swabia were great and flourishing duchies, the bases of leading branches of the German folk, from which sprang illustrious lines of emperors. As states they have long disappeared from the map, but Baden, Württemberg, and Hesse occupy today parts of their former territory.

How welcome is the change from the Prussian north to the friendlier and more picturesque land and people of the south of the Rhineland! Instead of monotonous level plain, we have fertile valley, wooded upland, and occasional rounded mountains; and everywhere ruined castles, quaint old cities rich in historic and artistic memories, and peasant costumes for men and women gay with color and silver and velvet ornaments. To the agricultural products of the north, we here add wheat, flax, and tobacco. In Bavaria grow the hops which produce the famous German beer, and in the Rhineland are wonderful vineyards. And everywhere we see churches and shrines, for South Germany and the Rhineland are as staunchly Catholic as the north is Protestant.

Coming from France the traveler today finds Strasbourg no longer a German but now a French city, for Alsace-Lorraine was restored to France by the Paris Peace Conference. Across the frontier, in the elbow of the Rhine, lies the former grand duchy of Baden—famous alike for its picturesque Black Forest (*see* Black Forest), and for Heidelberg, the seat of a great university and a beautiful ruined castle. The former kingdom of Württemberg, with its castle-crowned, vineyarded hills and rich forest slopes, is filled with memories of old Swabian days; but its capital Stuttgart is a flourishing modern city.

These wooded highlands of the south raise the total of Germany's forest area to one-fourth of the whole

THE HOME OF THE KAISER IN THE DAYS OF THE EMPIRE



We are looking down from an airplane on the royal palace and pleasure grounds formerly occupied by the German emperors at Potsdam, 16 miles from Berlin. The palace stands in the midst of the famous Sans Souci Park. It was completed by Frederick the Great in 1769, and was the summer residence of William II until his downfall. For years the very name "Potsdam" was a synonym the world over for Prussian military autocracy.

land. Beech, oak, pine, spruce, and birch are among the most important growths. The state governments strictly control the forests, even where they are privately owned; and no one may destroy a tree without planting another. Thus the forests are never exhausted, and the evil effects on climate and soil of deforestation are avoided (*see* Forests and Forest Protection). In some parts of Bavaria the wood industries are almost the sole resources of the people. Even on the lordly Rhine great timber rafts are frequently met with floating downstream to Mainz and other furniture-making and wood-using cities.

Bavaria's Beauty and Splendid Cities

In the former kingdom of Bavaria the traveler finds not only the best of old-time Germany alongside the products of modern art, science, and industry, but also the loveliest scenery of that country (*see* Bavaria). Here only does Germany touch the Alps, for the Austro-Bavarian boundary runs along the ridge of the Northern Tyrolese or Bavarian Alps, and in the distance are seen the far-off majestic peaks of the Vorarlberg. Thoroughly Alpine are the little Bavarian towns of Garmisch and Mittenwald; and the numerous upland lakes—Chiemsee, Starnberger See, Ammersee, and the rest—are altogether lovely. The Zugspitze (9,738 feet), 57 miles south of Munich, is the highest peak in Germany. In this Bavarian hill country, also, are unique castles like New Schwanstein and Linderhof, modern built, but medieval in appearance; these were the extravagant work of Bavaria's mad, romantic, unhappy kings, Ludwig and Otto.

Bavaria's cities, too, may well be her pride. The art-loving capital Munich (*see* Munich), on the swift-rolling Isar, has a charm lacking to Berlin. Augsburg, Nuremberg, Regensburg, and Passau, each has an interest all its own. And where can Wagnerian opera be heard so well as at Bayreuth (*see* Wagner, Wilhelm Richard), or religious drama seen to better advantage than at Oberammergau?

Augsburg dates from Roman days, and bears the name of the Emperor Augustus. It is filled with memories of trans-Alpine commerce with Italy in the Middle Ages; and here may still be seen the house, rich with its frescoed exterior, of the Fugger merchant prince who lent enormous sums to the Emperor Charles V. A well-known painting pictures for us the scene when the head of this great banking family astonished the emperor by laying on the fire the promissory notes which Charles had signed, thereby releasing him from the debt. Nuremberg is so important and picturesque that it is described elsewhere.

Forty miles to the west of Nuremberg lies the little

THE FAMOUS THEATER AT WEIMAR, THE "ATHENS OF GERMANY"

Although this handsome theater was built as late as 1907, it is hallowed ground to admirers of German literature, for it stands on the site of the old theater built in 1825 under Goethe's supervision. About it cluster memories of the golden age of German drama, for here many of Goethe's and Schiller's plays were staged for the first time, and here too several of Wagner's operas had their original performance. The monument before the theater is Goethe and Schiller, whose memory dominates the whole town. Weimar was also the place where the German Assembly drew up the constitution of the Republic in 1919.

town of Rothenburg-on-the-Tauber, with city walls, town hall, and ancient churches and houses much as they were 500 years ago. It is one of the best preserved medieval cities in existence. Every year a play called 'The Master Draught' is given here showing how, in the terrible days of the Thirty Years' War, the burgomaster delivered his people from the wrath of the victorious general Tilly—by drinking without once stopping for breath a tremendous flagon of excellent Rothenburg wine!

Between these two older Germanies of the north and of the south lies a third, the gigantic growth of the last half-century—the black industrial region of central Germany. It comprises three chief areas—the Rhine-Westphalian region lying on both sides of that river north of Cologne, the Saxon districts to the northward of Bohemia, and Silesia. About Berlin also is an extensive industrial region, but it lacks the nearby coal which makes the chief advantage of each of the other areas. Not even the United States grew more rapidly in manufactures than did Germany between 1891 and 1914.

Even today, after losing the rich coal fields of the Saar basin to France and part of those of upper Silesia to Poland, Germany possesses mines of coal and iron more extensive than any other European country except Great Britain. In addition there are extensive zinc, copper, lead, and salt deposits and some gold and silver. Formerly Germany possessed almost a monopoly of the world's supply of potash and even today her mines at Stassfurt (in Prussian Saxony) are the chief source of those salts, so important for fertilizers and the chemical industry.

The Ruhr coal field, which is the richest in Europe, supplies the secret of the great Rhine-Westphalian industrial development. Its coal feeds the fires of innumerable blast furnaces, including the vast Krupp iron works at Essen, once the seat of Germany's manufacture of monster cannon, munitions, and armor plate, but now confined to locomotives, ship engines, and other peace-time work. Solingen is renowned for its knives and cutlery, Iserlohn for needles. Near by are Barmen and Elberfeld, twin cities famed for their cotton manufactures and called "the German Manchester." On the left bank of the Rhine, in the region under Allied occupation following the World War, are Krefeld, the chief seat of the German silk and ribbon manufacture, and Düsseldorf, the banking and residence center of the district. Even the factory cities show few slum districts, and German city governments and working-class legislation were long regarded as the most enlightened in the world.

ONE OF THE GREAT STEEL WORKS OF GERMANY

Here we are on the grounds of one of those great steel plants which made the city of Essen and the name of Krupp famous throughout the world. Before the World War, these huge German plants were largely engaged in turning out military supplies—cannon, shells, armor plate, etc. And the millionaire masters of these plants actively fostered the war spirit in Germany. Since the World War, they have in truth been compelled to "beat their swords into ploughshares and their spears into pruning hooks"; for the Allies made it one of the peace terms that the great German steel factories should cease making munitions of war.

The industrial district of Saxony is similarly based on the Saxon coal field. From Chemnitz and Zwickau, German stockings, knit underwear, and other goods made from imported cotton were shipped all over the world. The fine wools grown in Saxony and Silesia made these regions great centers also for woolen textiles. The clay deposits at Meissen, near the Saxon capital Dresden (*see* Dresden), give rise to potteries for the manufacture of the famous "Dresden ware." Many of the chemical and electrical industries—especially the manufacture of aniline dyes, in which Germany led the world—are located in this region. Leipzig, the seat of one of Germany's chief universities, is also one of the greatest book-publishing centers in existence (*see* Leipzig).

A highly developed railway system, supplemented by an equally highly developed system of river and canal transportation and splendid roads, aided this industrial growth. In part, too, it was due to the fostering care of the German government, and to the disciplined labor of the German people, trained to obedience and to avoid everything placarded *Verboten!* ("Forbidden"). But still more must it be credited to the patient thoroughness with which Germany, far more than any other country, applied to manufacturing the results of chemical and physical research, in which German universities led the world, and to the German system of technical schools.

Germany after the World War

Only by slow degrees can Germany recover the prosperity destroyed by her reckless policy of "World power or downfall!" The peace terms imposed by the victorious Allies at Paris were crushing. Germany was condemned to pay huge indemnities that must burden her for many years. She was forced to surrender her navy, give up most of her munitions of war, and limit her army to 100,000 men. Alsace-Lorraine, her Polish territories in the east, part of Schleswig, and the colonial empire she had been building up for over 30 years were all surrendered. Finally all her remaining territory on the west bank of the Rhine was to be occupied by the Allied armies for 15 years, as a guaranty for her faithful execution of the treaty (*see* World War of 1914–18).

A far-reaching political and social revolution accompanied the signing of the armistice (Nov. 11, 1918) and the negotiations for peace. The Kaiser had fled unlamented to Holland, the kings and princes of the German states abdicated or were deposed, and republican governments everywhere took their place.

BEAUTIFUL HEIDELBERG, CITY OF THE FAMOUS UNIVERSITY

If you were a student at the famous German University at Heidelberg, this is a view which would often delight your eyes. The town lies between lofty hills covered with vineyards and forests. We are looking down from Bismarck Heights across to the point where the river Neckar enters the plain of the Rhine. At our feet is the historic Heidelberg Castle built in the 14th and 15th centuries. The University buildings cannot be well distinguished, but they lie immediately beyond the high steeple near the left end of the picture.

A radical "Spartacan" revolt, akin to the Bolsheviki of Russia, broke out in January 1919; but it was ruthlessly put down by the moderate socialists who controlled the provisional government.

The new constitution of Germany—framed by a convention which met at Weimar, a city associated with Goethe and Schiller and far from Berlin mobs—went into effect on Aug. 11, 1919. The framework of the new government resembled that of the German Empire but the spirit was one of democracy. Germany was made a republic, with equal vote for all Germans, both men and women. The 25 federated states, now become republics, retained most of their former rights.

The president of the German Republic was to be elected for seven years by direct vote of the people. The administration was placed in the hands of a responsible cabinet, headed by the chancellor. A Federal Council succeeded to the powers of the old *Bundesrat*, but the popularly elected *Reichstag* (national council) was strengthened. The principles of proportional representation, initiative referendum, and recall were incorporated in the constitution, and it was made easier of amendment than the Constitution of the United States.

Finally, a broad bill of rights established personal liberty and equality and abolished all privileges attached to titles of nobility. The constitution also provided for the ownership of all railroads, telegraphs, and telephones by the central government, and left the door open for the full establishing of socialism by the future transfer of private business enterprises to public ownership.

Frederick Ebert, a labor union leader who had formerly been a saddler, was elected the first president, and took up the work of rebuilding in the legislative halls of Berlin that had seen the triumphs of Bismarck. The people indeed had begun to rule!

Two Thousand Years of German History

As far back as we have any record, Germans have inhabited the greater part of this land, but their remote ancestors probably came from the grass-lands of southern Russia. Romans and wandering German tribes fought one another as early as 113 B.C. While Julius Caesar was governor of Roman Gaul, which extended to the Rhine, he drove back two German tribes who had settled west of that river (55 B.C.).

THE STORIED "MOUSE TOWER" NEAR BINGEN ON THE RHINE

Countless old folk-tales and legends cling about the historic structures that dot the Rhine valley. Few of these are more startling than the legend of the Mouse Tower, which you see here at the foot of the terraced hills. This tower stands on a small island near the town of Bingen. The story goes that in the 10th century the cruel Bishop Hatto of Mainz caused a number of poor people who were clamoring for bread to be burned to death in a barn. He then took refuge in this tower, the legend runs, where he was attacked and eaten up by an army of rats as a punishment for his cruelty! It is a cheering relief from this grewsome tale to learn that it couldn't possibly be true, for the tower was not built until 200 years after the bishop was dead.

In the year 9 A.D. a Roman army was entrapped and destroyed by a German chieftain named Arminius (Hermann) in the Teutoberg Forest in northwestern Germany. About a century later the Rhine and Danube rivers were definitely established as the boundary of the empire. Their upper courses were connected by a frontier wall of earth and stone, which ran over the hills, valleys, and rivers of Swabia near the junction of the river Main with the Rhine.

The Roman historian Tacitus (98 A.D.) described the Germans as a rough barbarian people, tall of stature, with fair skins and blue eyes. They lived in rude villages in their gloomy forests, wore garments of skins, and the men spent their time chiefly in war and the chase. Their spirits were free and independent as befitted rude warriors. The women cared for the cattle and raised scanty crops. They worshiped Woden, the god of the sky; Thor, the thunder god, whose weapon was a hammer; and many other ancient deities.

Two hundred years later the Germans—now formed into great groups or nations called Goths, Franks, Frisians, Saxons, Vandals, and the like—began to press into the weakened Roman Empire. When the period of the migrations was ended, the Roman Empire had fallen in the West. Most of the barbarian conquests were absorbed into the kingdom of the Franks, which reached its height under Charlemagne (*see* Charlemagne). The break-up of the Frankish Empire in the Partition of Verdun (843 A.D.) marks the real beginning of both France and Germany as separate states.

Between the two countries lay a middle strip called Lorraine, which at this time extended westward from the Rhine to the Scheldt River and from the Vosges Mountains to the North Sea. For a thousand years this region was the object of conquest and the seat of European wars, and in 1914 Germany possessed about one-third of it. On the east Charlemagne's effective empire had extended only to the Elbe River and its tributary the Saale, beyond which line dwelt Slavic tribes. The eastward extension of German rule

A CITY OF OLD TRADITIONS AND GREAT WEALTH

Frankfort-on-the-Main is one of the most interesting as well as wealthiest of German cities. It lies at the junction of lines of railway connecting directly with all the principal cities of South and Central Germany. As the home of the original Rothschilds, Frankfort is one of the great financial and banking centers of the world. The town was settled in Roman times, and one of the legends with regard to it is that the great emperor Charlemagne, when retreating before the Saxons, got safely across the river at this point by following a doe which appeared by miracle. One of the great fairs of the Middle Ages used to be held in Frankfort.

to the Vistula and Memel rivers, with accompanying German colonization at the expense of the Slavs, was the work of another ten centuries.

The conversion of the Germans to Christianity was the work of Irish monks and then of the Englishman, St. Boniface, the "Apostle to the Germans" (*see* Boniface, Saint). The Saxons of North Germany, however, remained heathen until the time of Charlemagne, when they were converted by the sword.

For several hundred years after 843 Germany was divided into a number of great "stem duchies," each the home of a separate stem or branch of the German people. The chief of these duchies were Bavaria, Swabia, Franconia (on the middle Rhine and its tributary the Main), and Saxony (from the Ems River to the Elbe, north of Franconia). The Franconian duke was the first to become German king after the ending of Charlemagne's line (911). Then for five generations the Saxon dukes wore the crown. The greatest of this line was Otto I, the Great (936–973), who revived Charlemagne's empire. It included Germany and Italy, but not France. Following the Saxon kings the Franconian (or Salian) house again ruled. In its time the empire was convulsed by a great "Investiture Conflict" between church and state, led by the Emperor Henry IV (1056–1106) and Pope Gregory VII (Hildebrand), and their successors. After the Salian emperors came the Hohenstaufens, so called from their castle in Swabia. Frederick I, called Barbarossa or "Red Beard" (1152–1190), and his grandson, Frederick II (1215–1250), were the most important of the Hohenstaufen emperors, and each of those rulers also was engaged in long conflicts with the papacy.

Feudalism and the attempt to rule Italy along with Germany broke up the stem duchies into a thousand or more fragments. Everywhere arose robber barons, who ruled from their hill-top castles by *Faustrecht* ("fist law"). Italy, as was said by Rudolf of Hapsburg (1273–91), the first of his house to become emperor, was "the den of the lion," with many tracks leading in and none coming out. So Germany remained an elective monarchy, weakened by its connection with Italy, while France, England, and Spain were building up strong national kingdoms based on the principle of hereditary rule.

But the strength that ebbed from the German kingship grew in the hereditary princely states. The Golden Bull (1356) of Charles IV definitely fixed the right to elect the emperor in the "Seven Electors"—the archbishops of Mainz, Cologne, and Treves, the Margrave of Brandenburg, the Elector of Saxony, the Count Palatine of the Rhine, and the King of Bohemia. By confirming the powers of these and other princely states, and of the numerous "free cities," Charles IV "legalized anarchy and called it a constitution."

Even Charles V (1519–56), who in addition to Germany ruled the Netherlands, Spain, Austria, Naples, and Sicily, and large parts of the New World, was unable to put down the Reformation started by Luther, and one of the chief reasons was the support given it by the rulers of important German states. The terrible Peasants' War of 1525, in which the people of Swabia and Franconia sought to free themselves from the bonds of serfdom, only riveted their chains more firmly. The great religious struggle called the Thirty Years' War (1618–48) weakened the central power still further. Thenceforth the head of each of the several hundred German states was practically an absolute ruler, and the Hapsburg emperor was a mere figurehead, without power save in Austria and his other hereditary lands. Disunited Germany was depopulated, commerce almost destroyed, and the people burdened with heavy taxes to support the incessant wars.

SUNDAY IN A GERMAN VILLAGE

The people of the Black Forest are noted for their quaint costumes. On Sunday it is the custom for old and young to array themselves in their best finery, and after church to saunter through the village streets chatting and gossiping. These villagers are mostly makers of clocks, toys, and musical instruments.

But the latter part of the 18th century brought promise of better things. Frederick the Great increased his kingdom of Prussia at the expense of Austria and Poland by most unscrupulous war and statecraft, but he made his possessions a strong well-ordered state. He thus prepared the way for a closer union of Germany, under a new and stronger headship than that of Austria. At the same time intellectual Germany flowered forth in a national literature in which the names of Herder, Goethe, Schiller, and Arndt represent the choicest blossoms. An idealistic philosophy, immortalized by the works of Immanuel Kant, Fichte, Schelling, and Hegel, was mother of the fruits of this period.

The wars waged against Europe by Revolutionary France and Napoleon also helped, though again Germany was left trampled and bloody in the wake of battle. The crushing defeat of the Prussians at Jena (Oct. 14, 1806) compelled a reorganization of that kingdom, in which serfs were set free and the beginning made of the Prussian military system based on the principle of universal service. The mockery of the title "Holy Roman Emperor" was also at last ended when Francis II resigned that title and became simply emperor of Austria (1806).

After the fall of Napoleon the Congress of Vienna (1814–1815) grouped the German states—now reduced from several hundred to 39, including Austria—into a loose German Confederation. Its only head was a diet or assembly, composed of delegates appointed by the sovereigns, which met at Frankfort-on-the-Main. The powers of the diet were so feeble as to make it a laughing stock. It was only a veil behind which was concealed the inevitable rivalry of Austria and Prussia for leadership.

When the wars of democratic revolution from France again burst over Europe in 1848, the liberals of Germany—under men like our own Carl Schurz—arose in rebellion and demanded democratic government and a strong and united Germany. But when the German imperial crown—with Austria left out—was offered by them to King Frederick William IV of Prussia, he contemptuously refused it as one "picked up out of the gutter." A united Germany without Austria and without Prussian leadership was impossible and the revolution therefore failed. The movement for German unity lagged for another score of years.

The actual creation of the new German Empire was the work of Bismarck (*see* Bismarck, Otto von). For years he was Prussian delegate to the Frankfort diet, and so was in the thick of Austrian and Prussian rivalry for the German headship. He believed that only on the field of battle—by "blood and iron"—could that issue be settled. By skilful maneuvering Bismarck brought about war with Austria in 1866. Prussia's rival was decisively defeated at Sadowa (Königgrätz) and forced to submit to a reorganization of Germany which excluded Austria. The states of Hanover, Hesse-Cassel, Nassau, and the free city of Frankfort, which had supported Austria, were ruthlessly annexed by Prussia. The other German states north of the river Main then united with Prussia in a North German Confederation (1866–70). South Germany was left out, for Bismarck knew it must ultimately join unless France blocked his plans.

Four years later Bismarck tricked France also into declaring war, in which she was crushingly defeated and Paris taken. France was forced to pay a billion dollars' indemnity, and cede Alsace-Lorraine to Germany. The enthusiasm aroused by this war brought the south German states into the new Prussian organization. It was completed by the proclamation in the French royal palace at Versailles (Jan. 18, 1871), of the new German Empire, with the king of Prussia as perpetual German Emperor (Kaiser).

In the popularly elected Reichstag, or legislative chamber, Prussia had 236 representatives out of 397, and the assembly's power was so limited that it was at times called "the Hall of Echoes." The real power lay with the Prussian war-lord as emperor, who claimed to rule by "divine right," and with the Bundesrat or Federal Council. The members of this body were delegates appointed by the sovereigns of the German states. Here Prussia had 17 votes (plus three of Alsace-Lorraine after 1911) out of a total of 61. The chancellor, who headed the administration, was responsible only to the emperor and not to the Reichstag.

The dream of centuries was achieved. Germany was united, but in the saddle was militarist Prussia with its belief in war as the handmaid of diplomacy and the state as the ultimate end. Would the easy-going, artistic, philosophical, individualistic, and literary south be able to curb militarism and the spirit of conquest allied now with all the great business interests of the new Germany?

Under the skilled leadership of Bismarck as chancellor, in the reigns of Emperor William I (1871–88) and Frederick III (March–June, 1888), the new empire grew rapidly in vigor, industrial prosperity, and power. Troubles arising with the Church of Rome were settled. Far-sighted laws were passed giving pensions under government control to laborers disabled by accident, sickness, or old age. The beginning was made of a colonial empire which ultimately included about 1,000,000 square miles in Africa (Togoland, Kamerun, German Southwest Africa, German East Africa) and 100,000 square miles in China and the Pacific islands (Kiaochow Bay in Shantung province, Kaiser Wilhelm's Land in New Guinea, Bismarck Archipelago, Caroline Islands, etc.).

Two years after the accession of Emperor William II (1888–1918), Bismarck was abruptly dismissed by the impetuous young Kaiser. The latter's aggressive foreign policy, hostility to the Hague conferences, increases of the army, naval rivalry with England, flirting with "Pan-Germanism," and support of Austria in the Balkans, together with such projects as the Berlin-to-Bagdad railway extending German commerce and the threat of her military power to the Persian Gulf and the Suez Canal; above all, his incessant "rattling of the sword" in its sheath, demands for "a place in the sun," and boasts that nowhere in the world should any great decision be reached "without Germany and the German Emperor"—those were the things which marked the general prussianizing of Germany. In a world divided into hostile alliances and resounding with military and naval preparations, such a tone and policy indicated to an uneasy world what would be Germany's line of conduct at any time the military party thought the strategic moment had come in any one of the constantly recurring European crises after 1908. (*See* World War of 1914–18; *also* separate articles on chief German mountains, rivers, cities, and historical characters.)

MAN'S DEADLIEST FOE—*The Microbe*

Tiny Organisms Revealed by the Microscope which Cause Many of Our Bodily Ills—How Science Fights Their Poisons—The Endless Battle Waged against Them by the Blood

IF you told a savage who was ill with typhoid fever that the cause of his suffering was a creature so small that 10,000 of them put end to end would be less than an inch long, he would probably reply bitterly that you were taking advantage of his weakness to spin fairy tales. "Don't I know," he would say, "that an evil spirit has brought this upon me?" No magician or witch-doctor ever conceived of a creature half so startling as a microbe, a form of life so small it cannot be seen by the unaided eye, yet it claims more victims than all wars, fires, floods, earthquakes, and other deadly agencies put together.

GERM THEORY OF DISEASE. Most diseases, we now know, are due to the presence in the body of exceedingly tiny vegetable or animal organisms, which produce poisons that attack the system. These poisons interfere with the functions of the body, cripple or destroy its various organs, bring about decay and often death. This is believed to apply to nearly all diseases in men, beasts, and even trees and plants, although the germs of some diseases have not yet been discovered.

We must remember that the world about us—soil, air and water, plants and animals—is filled with millions of invisible living beings called *micro-organisms*, from the Greek *mikros* meaning "small." These may be of the vegetable type, called *bacteria*, or the animal type, called *protozoa;* the difference is not important here. The great majority of these creatures are not harmful to man, even aiding him in many useful ways. (*See* Bacteria.) But others start a work of destruction as soon as they enter the human body, in the air breathed into the lungs, with the food we eat, or through the pores or cuts in the skin. These are the disease germs. In ordinary medical speech they are all grouped together as bacteria. These are divided into *bacilli* (rod-shaped), *cocci* (round), and *spirilla* (corkscrew shaped). The term "microbe" is a popular name for all bacteria.

TYPHOID BACILLI

These germs cause typhoid fever. Notice the "flagella" or tails.

The development of powerful compound microscopes in the 17th and 18th centuries had shown the existence of many micro-organisms, but it was not until the middle of the 19th century that their activity in producing disease was established. At that time, scientists observed that a particular form of bacillus was always found in the blood of cattle and sheep afflicted with anthrax, a violent disorder that killed thousands of the animals every year and even attacked human beings. But this observation was merely a beginning. To prove that these bacilli were the real cause of anthrax, they had first to be isolated, that is, separated from all other substances found in the blood of the diseased sheep or cattle. This was done, in 1863, by Robert Koch, a noted German bacteriologist. The anthrax bacilli then had to be grown in what is called a "pure culture"—that is, allowed to multiply under artificial surroundings without losing their poisonous strength. It was not until 1876 that Koch accomplished this and arranged the final test. A few perfectly healthy sheep were chosen for the experiment. In the presence of several eminent scientists, a quantity of the liquid containing the anthrax bacilli was injected into the blood of each of the sheep. Within a few days all had contracted anthrax and died. This is believed to have been the first conclusive proof that any specific disease is caused by a specific germ.

The anthrax experiment started a long chain of successful discoveries and tests which are continuing to this day. Scientists have isolated, one by one, the bacteria of blood-poisoning, erysipelas, cholera, typhoid fever, bubonic plague, pneumonia, meningitis, influenza, yellow fever, diphtheria, tetanus (lockjaw), tuberculosis, leprosy, whooping cough, and a score of other diseases. In the case of smallpox, measles, mumps, and a few others, no specific microbes have yet been observed, but they give all indications of being true germ diseases. Among the principal ailments which have been traced definitely to animal organisms (protozoa) are malaria, amoebic dysentery, and sleeping sickness.

TRYPANOSOMES

These protozoa are injected into man's blood by the bite of the tsetse fly and cause the deadly sleeping sickness.

Certain diseases which appear to be due to improper food, like beri-beri and pellagra, have not yet been placed in the germ class, although the faulty diet is believed by many authorities to be simply the agency which opens the way for some form of bacterial infection. Even in certain other disorders, which are traced to the failure of specific organs to function properly, and which are not classed as diseases in the strict sense, the question of indirect germ influence is sometimes raised.

Disease germs do their deadly work by forming poisons or "toxins" in the system. The symptoms of a disease depend upon the nature of these poisons and the positions in the body occupied by the germs which generate them. Some germs remain in the blood stream, which carries their poisons to all parts of the system. Others seek out special organs like the lungs, the stomach, the liver, the intestines, and the effects of their poisons are felt most powerfully in these localities. Certain toxins, like those of hydrophobia, attack principally the nerves, spinal chord, or brain.

Probably the greatest benefit resulting from the discovery of the germ theory was the fact that it solved most of the mystery of how diseases spread. By studying the habits of germs, scientists discovered how they grow, how they travel from place to place, and how they enter the human body. They learned that few disease germs can live long in the open air and sunlight, but that many thrive, like the typhoid bacillus, in impure water and milk, or like cholera germs, in various kinds of food which have been exposed to infection. It was found also that the meat of diseased animals often carried bacteria.

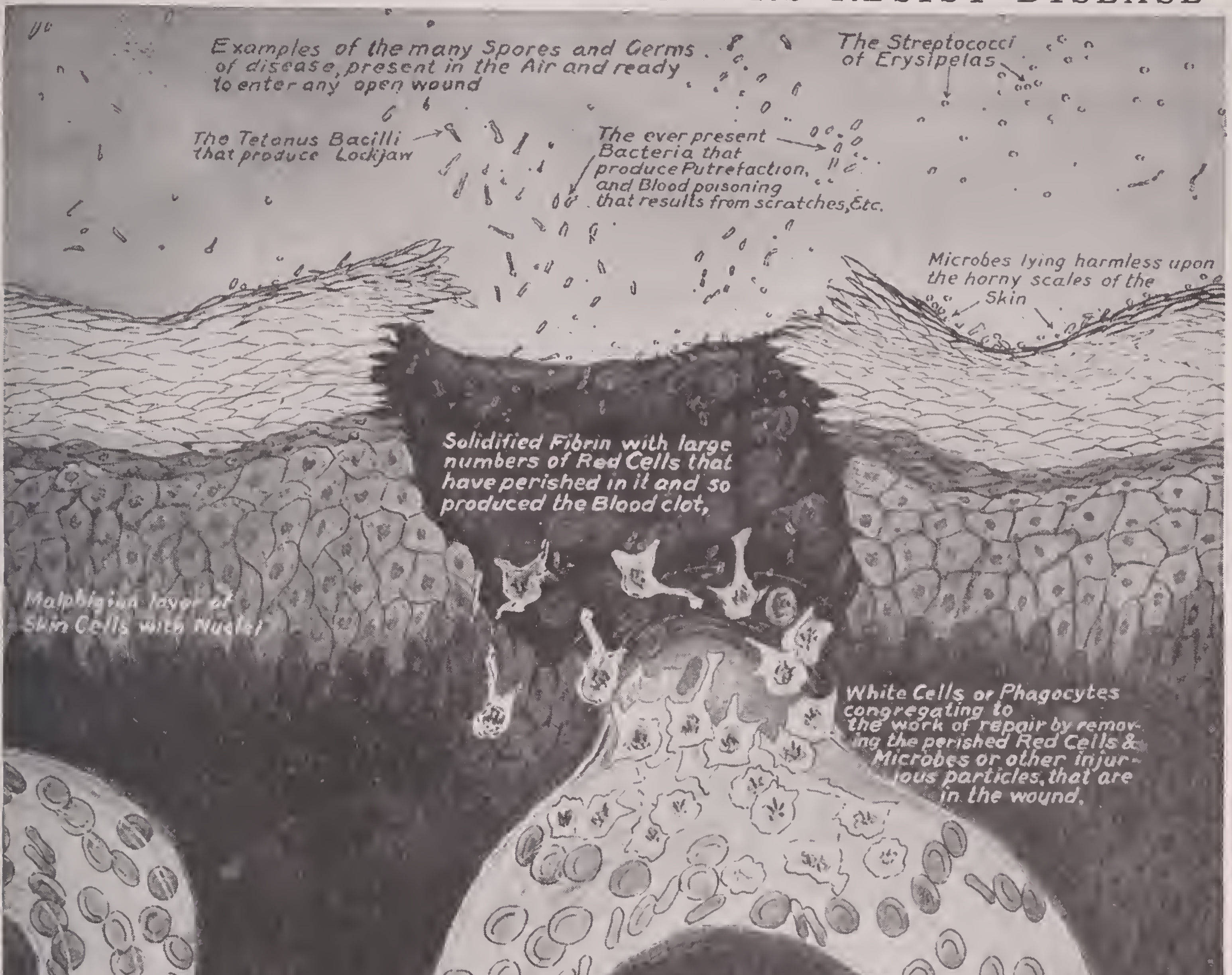
The entrance of many other microbes has been traced to cuts and scratches in the skin; this is true of the "micrococci" of blood-poisoning and erysipelas. In many of the so-called contagious diseases, like diphtheria, germs may be transferred by clothing or anything which has come in personal contact with one who has the disease.

Perhaps the most amazing of all these discoveries was that many deadly germs enter the body through the bites of insects. Malaria and yellow fever, for instance, are transmitted solely by certain types of mosquitoes (*see* Mosquito). Sleeping sickness is carried from person to person by the tsetse fly (*see* Tsetse

PLAGUE BACILLI

They look mild, but they have killed millions with bubonic plague.

HOW OUR INVISIBLE DEFENDERS RESIST DISEASE


Examples of the many Spores and Germs of disease, present in the Air and ready to enter any open wound
The Streptococci of Erysipelas
The Tetanus Bacilli that produce Lockjaw
The ever present Bacteria that produce Putrefaction, and Blood poisoning that results from scratches, Etc.
Microbes lying harmless upon the horny scales of the Skin
Solidified Fibrin with large numbers of Red Cells that have perished in it and so produced the Blood clot,
Malpighian layer of Skin Cells with Nuclei
White Cells or Phagocytes congregating to the work of repair by removing the perished Red Cells & Microbes or other injurious particles, that are in the wound.
Red Cells carried forward by the fluid elements of the Blood, which is composed chiefly of Globulin, Albumin and Fibrinogen
White Cell or Phagocyte travelling upwards in the Blood stream to the wound.

Here the artist has pictured on a greatly enlarged scale what goes on in a portion of skin no larger than the head of a pin, when disease germs try to enter through a cut or broken place. Beneath the skin is a tiny capillary, with blood passing through on its normal errands. When the skin breaks, the blood of course rushes into the opening. Contact with the air dries it into a clot which fills the wound. But imbedded in this clot are disease germs which had been quick to take advantage of the opening. The blood at once takes up the fight. Certain fluids—"bactericides"—try to kill them directly, by chemical action. Other fluids—"opsonins"—try to make them digestible for the white blood cells or phagocytes. These cells swarm to the point and eat the "predigested" germs. You can see several of them with their "meals" already inside. If the body is in good condition and the germs not too malignant, the blood will win; if not, the germs make good their entrance and disease begins.

Fly). The bubonic plague is transferred to human beings by fleas which have bitten diseased rats (*see* Black Death; Flea; Rat). Typhus fever, which scourged some of the war-ridden countries of Europe so terribly during the World War of 1914–1918, is apparently carried by the body-louse.

DIPHTHERIA BACILLI

Thanks to antitoxin, these germs have lost much of their terror.

While the danger from germs of all kinds must be carefully considered by persons who wish to avoid disease, this danger must not be exaggerated. Not every disease germ which enters the human body actually causes trouble; otherwise we would be ill most of the time, for we take in germs with nearly every breath and every mouthful of food and drink. In the blood and tissues of all healthy persons there is a tendency to resist and destroy unwelcome visitors. Many individuals, in fact, seem to be naturally immune to certain maladies; the germs can get no foothold in them. It is when the body is allowed to weaken through bad habits, overwork, improper food, insufficient exercise, etc., that microbes find themselves able to launch their deadly work.

CHOLERA GERMS

These bacteria are of the "corkscrew" or spirillum type.

Few germs are able to penetrate the human skin. The favorite breeding places of the *streptococci* or pus germs are the teeth and the mucous membranes of the nose, mouth, and throat. And these streptococci not only produce a great many disorders themselves, but they are a sort of advance agent, paving the way for other disease germs. Breathed in from the air, they find lodging perhaps in the folds of the tonsils, and if the tonsils have been weakened by mouth-breathing, by dust-laden air, by exposure to extreme heat or cold, the germs may thrive and start forming pus, which soon gets into the blood stream and infects the whole body. Or maybe the teeth, through improper care, become refuges for germs. Perhaps decay has opened a door to the tender nerve fibers which run up through the roots or perhaps the disease called *pyorrhea* has loosened the gums so the germs find their way far into the teeth sockets. In any case, pus pockets may be formed, which after a time cause little or no pain but which nevertheless poison the entire system producing rheumatism, abscesses, and a general low physical morale, which invites disaster. Certain forms of heart disease and of pneumonia, certain cases of appendicitis, and even gall-stones have been traced to germ infections in remote parts of the body.

THE "WHITE PLAGUE" GERM

These curious striped bacilli are the cause of the dreaded tuberculosis.

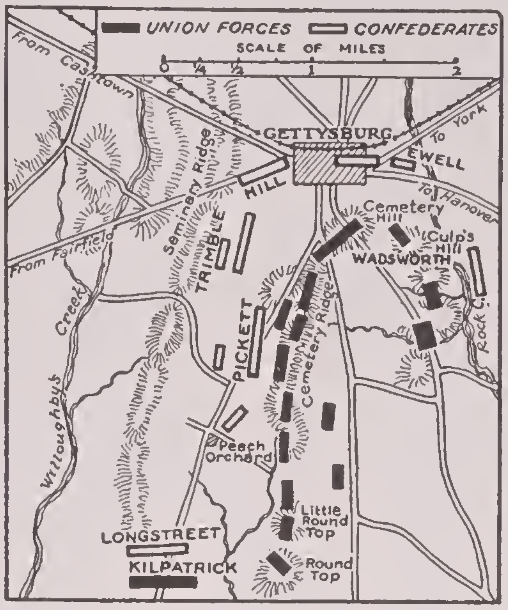
There are three ways of fighting the diseases caused by germs: (1) by the general destruction of the germs; (2) by preventing them from entering the human body; (3) by overcoming their evil effects, after they have made their way in. The first of these methods is usually carried on by public sanitation, which strives to do away with the breeding places of germs by disposing of sewage and garbage, by keeping water supplies free from contamination, and so on (*see* Health Department). The second method is illustrated by personal cleanliness, using disinfectants in wounds, the proper care of the mouth, nose and throat, boiling drinking water, fumigating sick-rooms, etc. (*see* Antiseptics). The last method includes the whole field of curative medicine and surgery, with particular emphasis on vaccine and serum treatments, and the use of specific drugs (*see* Antitoxins).

Despite all that has been done to solve the problems of medicine since the discovery of disease germs, there still remains an immense field for the scientist to explore. Almost every day a microscope, focused on a spot no bigger than the head of a pin, uncovers some life-saving secret, and the world knows no greater heroes than the men who devote their lives in obscure laboratories to the battle against man's worst foe—the microbe.

GERRYMANDER (*ḡĕr′ry-măn-dẽr*). In 1812 the Democratic-Republican party was in power in Massachusetts, but could not hope to retain its control in the approaching elections. To save something for the party, the legislature passed and Gov. Elbridge Gerry, later vice-president, signed a reapportionment bill constructing at least one representative district of exceptional unfairness. A Federalist editor, wrathful at the trick that was played upon his party, hung a map showing this district over his desk where all might see it. Gilbert Stuart, the famous painter, noticed the monstrosity one day, and with his ready pencil added head, wings, and claws, exclaiming, "That will do for a salamander." "Better say Gerrymander," growled the editor, a bitter opponent of Governor Gerry. The uncouth name for this political trick passed into current use, and today is to be found in any dictionary of the English language.

The "gerrymandered" district may be a city ward, a legislative district, or a congressional district. The purpose is to pack hostile majorities into two or three populous districts, leaving the rest "safe" for the party in power and thus giving it a larger number of representatives than its votes really warrant. One famous southern congressional district in which the negro vote was concentrated was 300 miles long and 20 wide. Happily an aroused political conscience has diminished the number of such extreme cases of gerrymandering.

THE CLIMAX OF GETTYSBURG



After unfruitful attacks on Round Top and Culp's Hill on July 2, Lee sent his assaulting columns, led by Pickett's division, against the Federal center on Cemetery Ridge on the afternoon of July 3. When this attack also failed, Lee accepted defeat and withdrew from Northern soil.

GETTYSBURG, BATTLE OF. "The most terrific combat on record"; "A great and glorious victory for the Potomac Army"—these were some of the headlines that appeared in Northern newspapers on July 4, 1863, after the close of the three days' struggle at Gettysburg, Pa. The South had expected a victory that would soon bring peace. For a time it seemed that they would not be disappointed, but in the end they failed, and from that time the tide of war set against the Confederacy.

In June 1863, General Lee had decided to carry the war into the North by an invasion of Maryland and Pennsylvania. This, he thought, would strengthen the peace party of the North, which was loudly demanding peace at any price. It would also give Virginia a chance to rest from the ravages of war, and if successful it might win some of the European nations to recognize the Confederacy as an independent nation. The time seemed ripe for the undertaking. The armies of the North were not in good condition. The terms of enlistment of many of the men had expired, and the commander of the Federal troops, General Joseph Hooker, already discredited by his defeat at Chancellorsville (May 1863), had resigned just a few days before the battle of Gettysburg as the result of a disagreement with the administration at Washington; General Meade was but newly appointed to take his place.

ROBERT E. LEE
Commander of the Confederate Army.

For two weeks General Lee had carried all before him. He had begun to cross the Potomac on June 15, had passed through Maryland, burned Chambersburg, Pa., and was pressing on towards Harrisburg, the capital of the Keystone State. For a time Northern leaders feared an attack on Washington, but when it became evident that invasion of Pennsylvania was Lee's object, Meade followed in hot pursuit.

Advance parties of the Confederate and Union forces met in conflict on July 1. Some of the Confederate troops were on their way to the village of Gettysburg to get the shoes of which they were sadly in need. There they met a detachment of Union troops, and the battle began. Success was with Lee's men on that first day. They drove the Federal forces back through Gettysburg, and captured their positions on Seminary Ridge. Meade meanwhile posted his main forces on Cemetery Ridge and next day Lee attacked each flank in turn. He won ground but his successes were not decisive. On July 3 therefore he staked all upon one grand attack against the center.

On the afternoon of July 3, the flower of the Confederate army, 15,000 strong, led by Pickett's division, advanced to the assault, a solid wedge of men. "Regiment after regiment and brigade after brigade moved from the woods. The red flags wave, their horsemen gallop up and down; the arms gleam in the sun, a sloping forest of flashing steel." A mile across the valley lay the Union troops, calmly awaiting the coming storm, while over their heads their artillery poured a hail of shot and shell into the advancing ranks of the enemy. Pickett's men were mowed down like grain. Great gaps appeared in their lines, but these were immediately closed. Their thinning ranks swept on until a small remnant, led by the gallant Armistead, crossed the Federal lines on the crest of Cemetery Ridge. The Stars and Bars waved over the Union defenses. But the price had been great:

A thousand fell where Kemper led;
A thousand died where Garnett bled;
In blinding flame and strangling smoke
The remnant through the batteries broke
And crossed the line with Armistead.

The few who remained could not hold what they had won at such a terrible cost. Attacked on all sides

GEORGE G. MEADE
Union Commander at Gettysburg.

THE TENTED FIELD OF GETTYSBURG, 50 YEARS AFTER

This city of tents is the temporary home of thousands of old soldiers of the Civil War, the "Blue" and the "Gray" together. These men, who years before were locked in deadly battle on the same field, met in friendship to help celebrate the 50th anniversary of the battle of Gettysburg, July 1 to 4, 1913. More than 7,000 tents were pitched on the field, a convincing testimony to the completeness with which the wounds of the Civil War had healed.

they threw down their arms and fled. Lee's great assault, one of the most desperate charges in all history, had failed.

There was nothing left for the Confederates but retreat. Slowly, on July 4, Lee gathered his men about him and started on the way back to Virginia. If Meade's army had not been worn out by the three days' fight it might have ended the war then and there. But Meade felt that his battered men were in no condition to pursue, and Lee was allowed to recross the Potomac in safety.

The Turning Point of the War

The battle put an end to Lee's hopes of invading the North, and it did far more. Up to that time, some political leaders of England had been strongly inclined to recognize the Confederacy as an independent nation; but when the news of Gettysburg flashed over the world, it put a halt to such projects.

Thus the turning point in the war was reached with the victories at Gettysburg and Vicksburg, which occurred at the same time. The struggle continued for nearly two years longer, and was marked by terrible battles; but from this time the strength of the Confederacy steadily declined, while the power of the Federal government as steadily increased.

Today the little town of Gettysburg stands in the midst of the silent memorials of the battle which was waged about it more than 50 years ago. A national cemetery, containing the graves of 3,629 soldiers, was laid out on Seminary Ridge, and at its dedication on November 19, 1863, President Lincoln delivered his famous Gettysburg Address. In 1895 the whole battlefield became a national park, within which are over 2,000 monuments, markers, and tablets, erected by states and regimental associations to show the visitor the spots where the different troops took part in this great conflict. In the World War it was taken as a training ground for the Tank Corps, and sons of the South and the North, now in the same uniform and under the same flag, camped where their forefathers had fought and fallen.

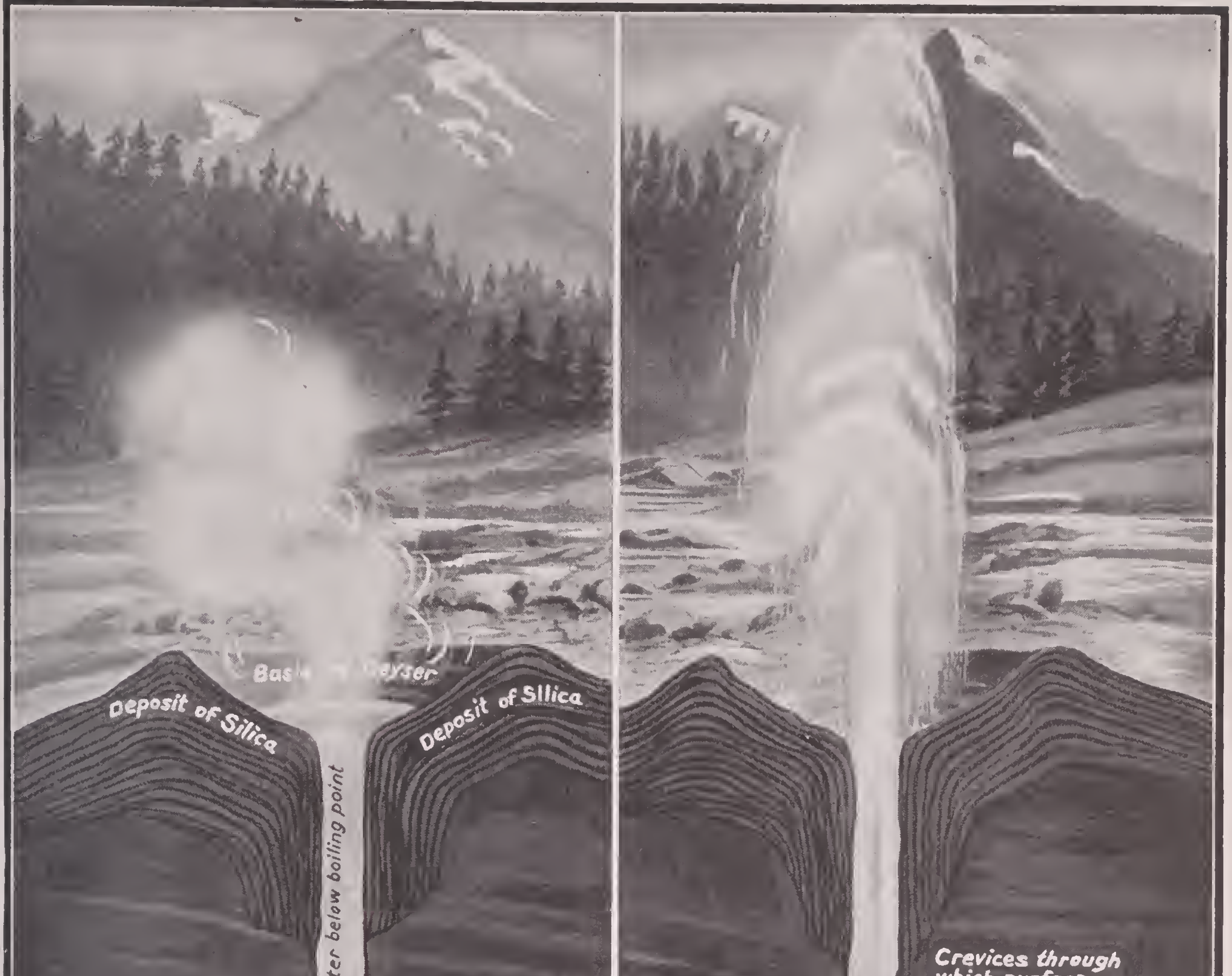
GEYSER. A hot spring which breaks forth in an eruption every now and then is called a geyser. They occur in certain regions of the earth which were formerly volcanic and which have retained considerable heat near the surface.

A typical geyser consists of a crater with a funnel-shaped opening into the earth. From this opening, at fairly regular intervals, a column of hot water and steam is ejected, sometimes to the height of a few feet, and sometimes to a height of 150 feet, as in the case of the geyser known as Old Faithful in Yellowstone Park. Until about 1870 Iceland was considered the principal seat of geysers, but we now know that Yellowstone Park contains more geysers than all the rest of the known world. New Zealand also has some noted geysers.

What Makes a Geyser Spout?

The action of a geyser was first explained by the chemist Bunsen, of Heidelberg, who went to Iceland in 1847 and made an elaborate study of the Great Geyser in that island. The water gathers in the deep throat of the geyser, becomes heated until the lower portion is changed into steam, when it flings the column of water above it violently into the air. Deposits of mineral matter, which was in solution in the ejected water, are often made about a geyser in the form of one or more basins. The deposition of the mineral matter is due partly to the cooling of the

THE PULSE BEATS OF THE BOILING GEYSER


Basin of Geyser
Deposit of Silica
Deposit of Silica
Column of Water below boiling point
Water up to here above surface boiling point (212° Fahr.)
Water far above surface boiling point filtering through from areas of greater heat
Crevices through which surface water filters into Geyser Tube
Explosion caused by sudden expansion of boiling water into steam

Here we can see how geysers like Old Faithful in Yellowstone Park keep such regular time with their spoutings, and how the beautiful geyser basins are made. Water at a temperature far above the surface boiling point, owing to its contact with the hot rocks deep down in the earth, gets into cracks in the rocks, dissolves them away, and forms channels for itself. Eventually these channels reach clear up to the surface. The upper part of the column of water is considerably cooler than the lower, so it acts as a kind of stopper in the geyser's throat and holds the boiling water down until it becomes so heated from below that it explodes into steam and sends the upper part of the column spouting up into the air. This hot water contains a large amount of dissolved matter, much more than it can hold when it cools. The excess material that it deposits when it is cooled by contact with the air builds up the basin about the mouth of the geyser.

water, partly to evaporation; but chiefly to the influence of minute plants (*algae*), which live about the geysers, and which have the power of extracting silica, etc., from solution. The beautiful colors of the deposits about geysers are due to the presence of the plants themselves. Some of the geysers of Yellowstone National Park throw up mud instead of water.

GHENT (*gĕnt*), BELGIUM. "It is the soul of Flanders, at once venerable and young. In its streets the past and present elbow each other." Thus the Belgian writer Maeterlinck describes Ghent, a thriving modern town which has yet many remnants of old-world charm. In it are the famous Cathedral of St. Bacon, a number of old gild houses and monasteries, and a nunnery founded in the 13th century, surrounded by walls and moats, and resembling a miniature town. In the center of the city the belfry still stands in which used to hang the bell "Roland" that called the citizens of Ghent to arms on the approach of enemies. There is much to remind the visitor of the medieval days when the city was the center of a great cloth industry and the home of the turbulent and wealthy burghers—"the sovereign town of Flanders for power, counsel, lordship, situation, and all that one can imagine as belonging to a good and noble town."

Ghent is a picturesque city, with a network of canals spanned by more than 200 bridges. Only eight miles in circumference, it contains extensive promenades and gardens and is sometimes called the City of Flowers. Situated where the Lys and Scheldt rivers meet, and connected with the ocean by a ship canal, it has considerable commerce in agricultural and manufactured products in addition to a large export trade in flowers. Though not so conspicuous for manufacturing as in the Middle Ages, it has many important industries. Chief among the city's enterprises are cotton-spinning, flax-spinning, cotton-printing, tanning, and sugar-refining.

The early history of Ghent is the usual history of Flemish towns—an endless series of quarrels between the townsfolk and their lords, between the aristocrats and the bourgeoisie, and against the rival city of Bruges. Two of the most famous of the insurrections were those led by Jacob Van Artevelde and his son Philip in the 14th century. Population, about 165,000.

GHIBERTI (*gē-bĕr'tē*), LORENZO (1378–1455). In the year 1403, in the beautiful Italian city of Florence, 34 judges sat with puckered brows vainly trying to decide which of two models for a pair of bronze doors was the more beautiful. The models were the best of those presented in a competition held to decide who should make the new doors for the Baptistery of Florence, a building which had once been the cathedral of the city, but which was now used chiefly for baptismal services. But the judges' brow-puckering did no good, for they could not decide which of the models should have the prize.

Then one of the young sculptors, Brunelleschi—he who a few years later left sculpture for architecture and constructed the wonderful dome of the great new cathedral near by—stepped forward, and, saying that his rival's model was more beautiful than his own, withdrew his design from the competition. The young man whose work so impressed his big-hearted rival was Lorenzo Ghiberti, and the bronze doors which he executed when he had thus won the competition are among the many beautiful works of the Renaissance.

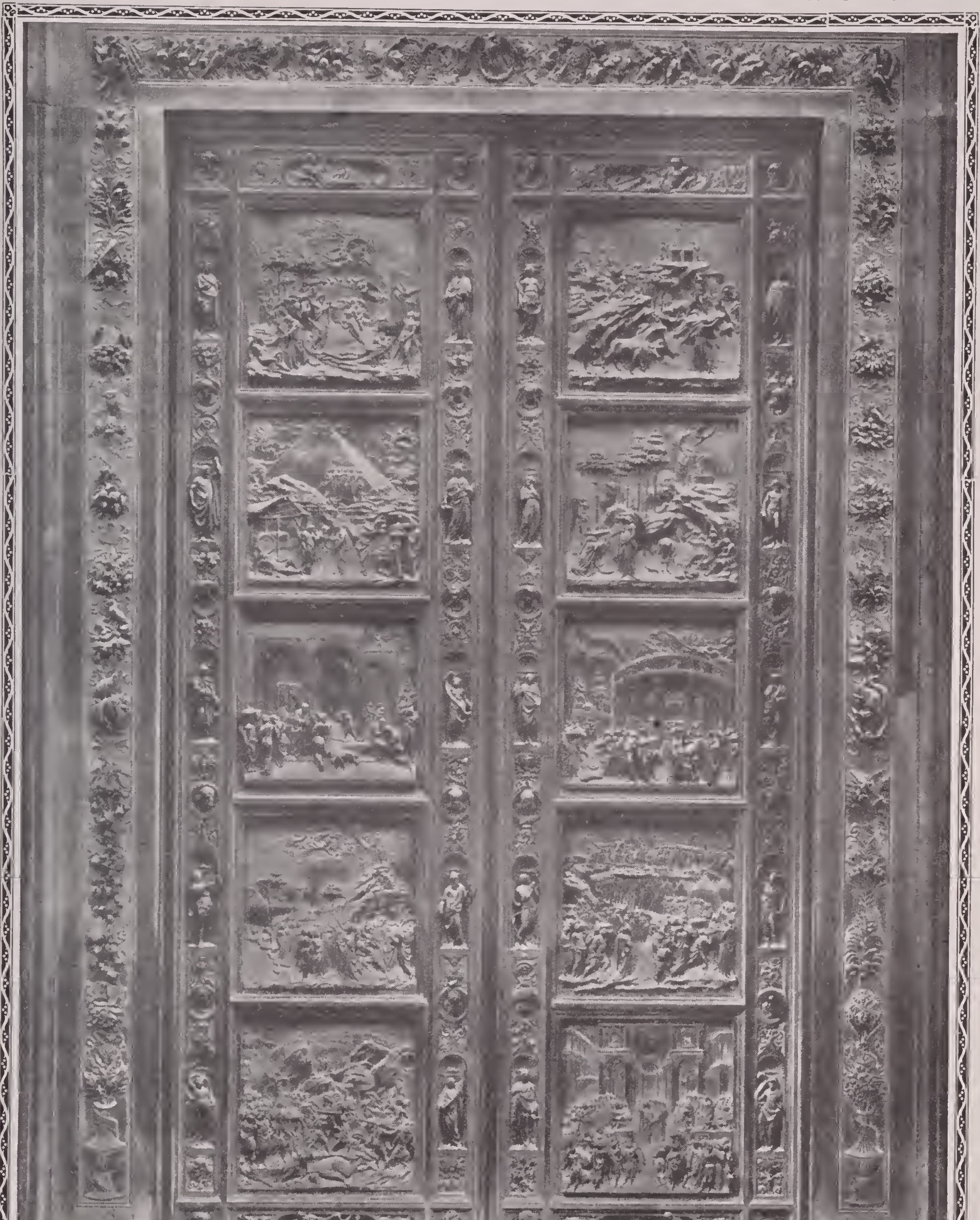
But far surpassing these in beauty and difficulty of casting are his marvelous second pair of doors for the Baptistery, executed by this great Florentine artist some years later. On these Ghiberti worked for more than 25 years. The subjects of their sculptures are stories of the Old Testament, and in some of the ten panels are as many as a hundred separate figures, modeled upon different planes in accordance with the newly studied laws of perspective. In the first are pictured the creation of man, the creation of woman, and the expulsion from Eden; in the second, the sacrifice of Abel, with Cain's oxen plowing in the foreground. Other panels picture the story of Noah, of Abraham, of Jacob and Joseph, of Moses, Joshua, David, and Solomon. Only less beautiful than the figures and background of these marvelous doors is the border of statuettes and busts surrounding each and the decorative frieze of fruits and birds and beasts that frames the whole.

The great Michelangelo, a hundred years later, being asked what he thought of these doors replied: "They are beautiful enough for the gates of Paradise."

Ghiberti's early training, like that of many other artists of the Italian Renaissance, was as a goldsmith, and the skill in minute detail which he thus learned never deserted him. When at 25 he was given the commission to execute his first pair of doors, several assistants were given him, among others his stepfather, also a goldsmith. The stories told in it are stories of the life of Christ and of the fathers of the church, and the modeling and casting took 21 years. All the people of Florence took the keenest interest in Ghiberti's work, paying patiently large sums of money for 50 years out of their taxes, and watching the designs grow with interest that never failed.

The double character of the Renaissance—enthusiasm for antiquity and enthusiasm for visible nature—are both shown very clearly in Ghiberti's second pair of doors. Ghiberti also executed several statues and reliefs and designed some of the most beautiful stained glass in the cathedral of Florence. He died at 77 years, full of honor and piety, caring nothing for money but only for his art and the religion it had been used to beautify.

GIBBONS, CARDINAL JAMES (1834–1921). The second American to be made a cardinal of the Roman Catholic church—the first being Cardinal McCloskey of New York—was James Gibbons, one of the outstanding figures in American public life. Born in Baltimore on July 23, 1834, he was taken by his parents to Ireland where he obtained his childhood education. He returned in 1848, living for a time in



This second set of bronze doors made by Ghiberti for the Baptistery of Florence are regarded as among the world's greatest masterpieces. "They are beautiful enough for the gates of Paradise," said Michelangelo when he saw them for the first time. Ten stories from the Old Testament are illustrated in those panels, and the details of the figures, the perspective, and the decorations are worked out with exquisite accuracy and grace. It was Ghiberti's early training as a goldsmith joined to his genius as a sculptor which enabled him to achieve such delicate beauty.

New Orleans. He was graduated from St. Mary's Seminary, Baltimore, and ordained a priest in 1861.

In 1866 he was appointed first vicar-apostolic of North Carolina with the rank and title of bishop. His work was marked with a thoroughness and success which led to his promotion to the see of Richmond in 1872. Here his zeal and ability were further demonstrated, and in 1877 he became coadjutor to Archbishop Bayley. On the death of the latter in the same year, Bishop Gibbons became archbishop of Baltimore. He presided at the plenary council of Baltimore in 1884, and Leo XIII, approving of the acts and decrees of this council, created him cardinal in 1886. In this high office he showed the qualities of a wise and able prelate, and gained wide influence, not only as a leading churchman but as a progressive and patriotic citizen.

JAMES CARDINAL GIBBONS

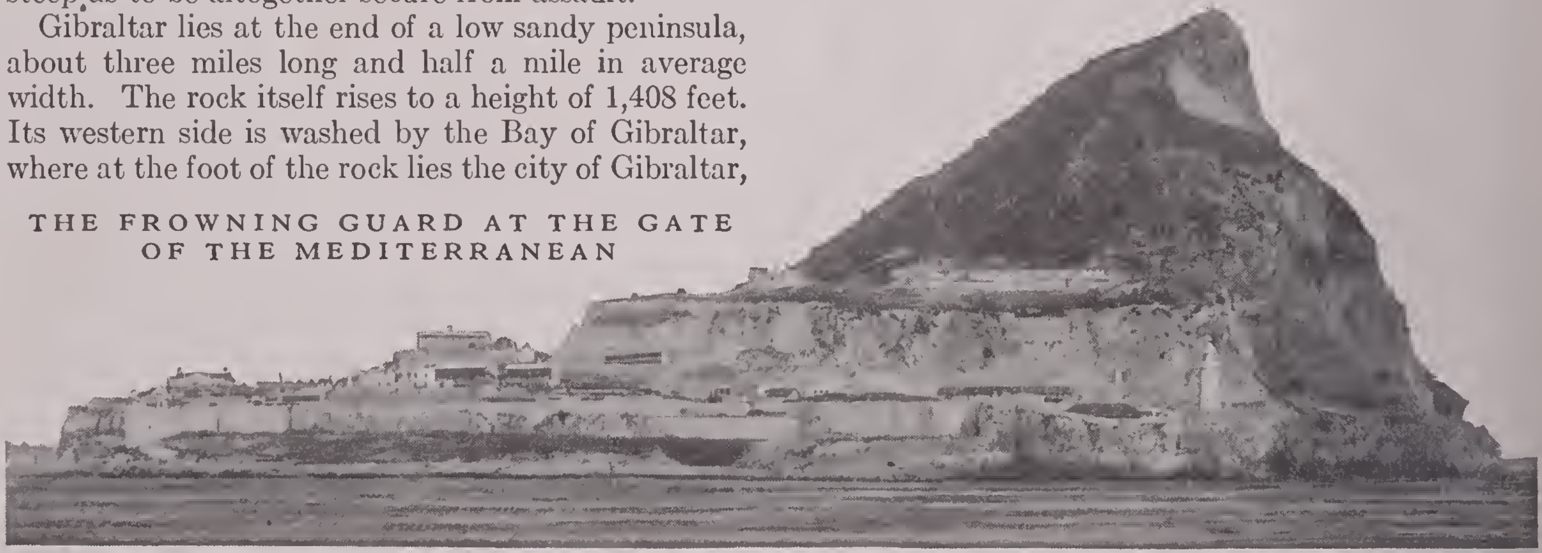
Famous American Churchman and Public Leader.

GIBRAL'TAR. Like a reclining lion dozing in the southern sun, the great rock of Gibraltar looks sleepily across the 12 miles of water which separate this southernmost point of Spain from Ceuta, on the African side of the strait leading into the Mediterranean. But in case of need this peaceful-seeming rock can leap into thunder and flame from powerful cannon which lie hid in many a waterside or rock-hewn battery. For Gibraltar for over 200 years has been a garrison and crown colony of Great Britain, her chief naval base on the Mediterranean route to India. The fortifications are so strong that the rock is considered impregnable. The eastern side is so steep as to be altogether secure from assault.

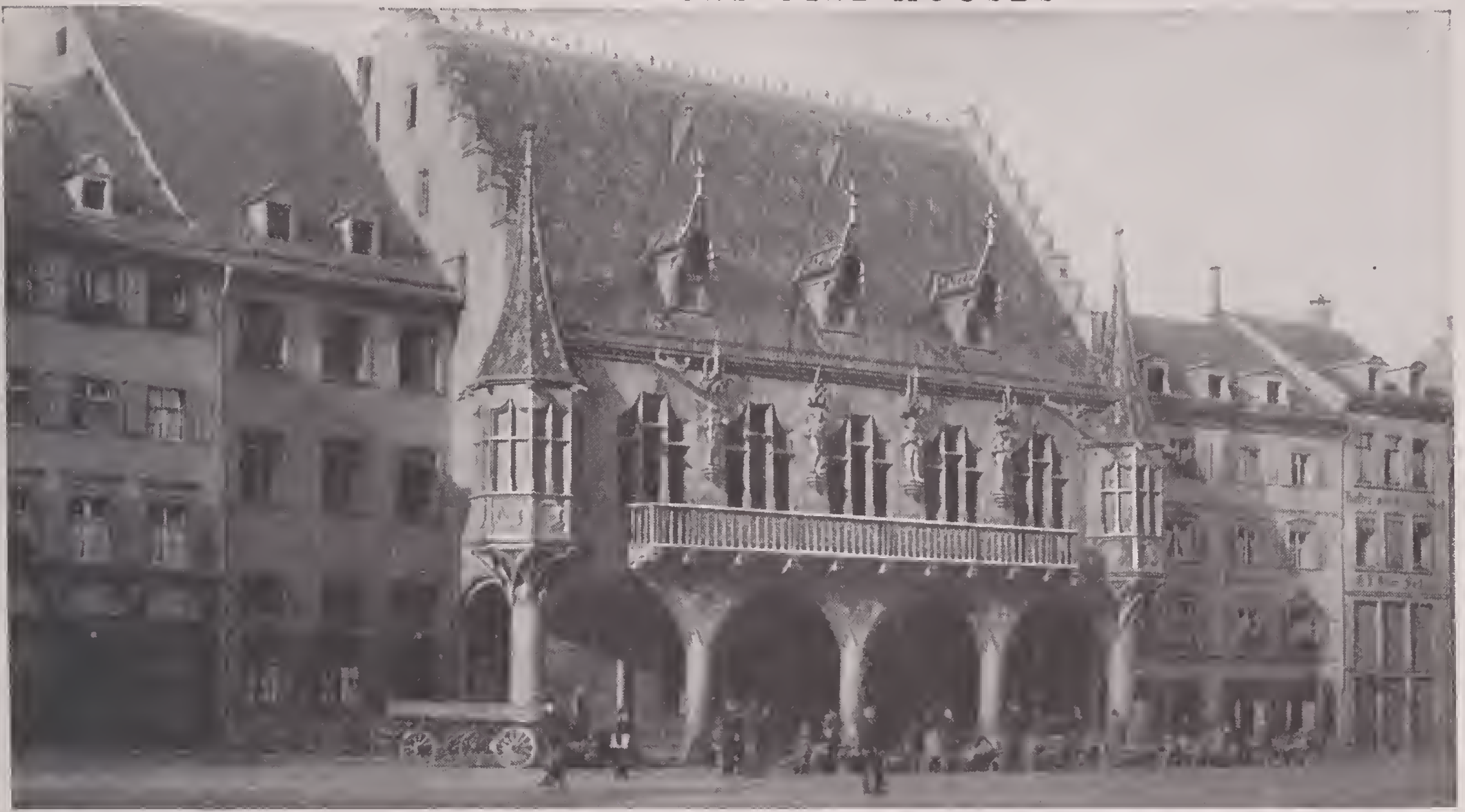
Gibraltar lies at the end of a low sandy peninsula, about three miles long and half a mile in average width. The rock itself rises to a height of 1,408 feet. Its western side is washed by the Bay of Gibraltar, where at the foot of the rock lies the city of Gibraltar, with a population of about 25,000, including the garrison of between 5,000 and 6,000 men. Aliens are not allowed to reside in Gibraltar without a special permit from the British authorities, and every effort is made to prevent the increase of population. At the northern end of the rock is an open space, part of which, lying between the British and the Spanish lines, is called the "neutral ground" and is uninhabited. Six miles across the bay from Gibraltar lies the Spanish town of Algeciras, where an international conference on Moroccan affairs was held in 1906.

Gibraltar, with its opposite African cape (where lies the Spanish town of Ceuta), was called by the Greeks the "Pillars of Hercules" and was once thought to be the western limit of the world. Gibraltar takes its name (Jebel-al-Tarik, "hill of Tarik") from the Mohammedan chief who led his troops across the straits in 711 A.D., captured it, and built a fortress there. In 1704 it was captured from the Spaniards by the British, and has remained in their possession ever since. It has endured many sieges, especially the great one of 1779–83, when for four years the garrison held out against a joint besieging force of French and Spaniards. This is regarded as one of the most memorable sieges of history. The culminating episode was the grand attack in September 1782, by a fleet especially equipped with massive wooden armor. Every attacking ship was finally blown up or burnt to the water's edge by cannon-balls heated red hot and fired from the Gibraltar batteries.

THE FROWNING GUARD AT THE GATE OF THE MEDITERRANEAN



This is the Rock of Gibraltar that looms above the narrow western entrance of the Mediterranean. Its peak is 1,400 feet above the sea, and hidden in its rugged sides of pale gray limestone are countless great British guns, commanding the 12-mile passage which separates Europe from Africa. Europa Point, on which the lighthouse stands, is the most southerly projection of the rock. The public gardens, the barracks, and the docks are situated on the Atlantic side.



ONE OF THE OLD GILD HOUSES

Here is a fine example of one of the old gild houses, the Kaufhaus, or Merchants' Hall, in Freiburg, Germany. The gilds built such halls to serve as meeting places and headquarters, and made them as handsome as their prosperity would permit.

GILDS. In every important town of Europe during the Middle Ages the men of each trade were organized into associations known as craft gilds for the purpose of regulating their occupations and preserving a monopoly. The weavers seem to have been the first to organize, but later the goldsmiths, saddlers, fishmongers, bakers, dyers, glovemakers, and many other occupations, some with only a handful of workers, formed separate fraternities. In the larger cities like Paris and London there were in the 14th century as many as 50 or more different gilds. Usually they were authorized by the local governments, but sometimes they obtained a charter from the king.

SHOPPING IN THE DAYS OF THE GILDS

Here my lord and his family are out for an afternoon of shopping. The merchant's apprentice is showing a fine piece of cloth and no doubt enlarging on its merits. My lord seems to be exclaiming at the price, while the merchant indicates by his fingers that he will reduce the price to this important customer.

The rules of the gild provided that no one who was not a member should practice the trade within the town. Membership in some places was acquired as a matter of course by any artisan who reached a required degree of skill; but at other times and places it was jealously guarded, descending to sons or being obtained by marriage.

The gild regulations required that all articles made and sold by their members should be of a certain quality. There must be, for instance, according to the rules of the weavers' gild, a certain number of threads to the inch in standard cloths. The hours of labor were regulated, and work on holidays and at night prohibited. In later times insistence on outworn standards and processes became a handicap in industry, and led to a shifting of manufactures to villages and new towns where gilds were not established.

Other gild regulations provided for mutual assistance, the care of sick and needy members, and of members' widows and orphans. Once a year—sometimes oftener—the members gathered for a feast (the word "gild" means "feast" or "payment"), and in summer, usually on Corpus Christi day, they often gave one of the miracle plays popular at the time (*see* Miracle Plays). Since the members of a craft usually lived on the same street, the craft gild was a natural center for the interests of its members.

Membership in a gild was ordinarily obtained by passing through an apprenticeship. The young craftsman was bound out by his parents to an employer for a number of years—usually seven—during which time he was fed and clothed and lodged with the master's family, above or behind the shop. When his apprenticeship was finished he became a "journeyman" (so called from the "wander year" in which he perfected himself in the craft by working about in other cities), and served for wages and worked for whomever he pleased. If he were ambitious and saved enough of his wages to start a small shop of his own, he might possibly become a master, with journeymen and apprentices under him, and could then take part in all of the meetings of his craft and hold office.

In addition to the craft gilds there were older and more powerful organizations called "merchant gilds," composed of men who made a business of buying and selling and engaged in what we should call wholesale trading to distant places. It was members of such organizations who formed the great Hanseatic League that was such a power in the Baltic lands, and even had quarters in the steelyard of London. On the continent the merchant gilds had a great influence in the city government, and the gild hall of the merchants is today one of the striking buildings in many a European city. Many non-industrial gilds existed, mostly founded for charitable and religious purposes.

GINGER. The history of ginger goes back to a remote period in India. The Greeks and Romans imported it, and during the Middle Ages it was next in value to pepper, a pound costing as much as a sheep. It was the first of the oriental spices to be grown in the New World, and as early as 1550 Jamaica exported a large amount to Spain. It is an important commercial crop in India, China, West Africa, in the West Indies, and in Central America. Jamaica ginger is the finest and most valuable.

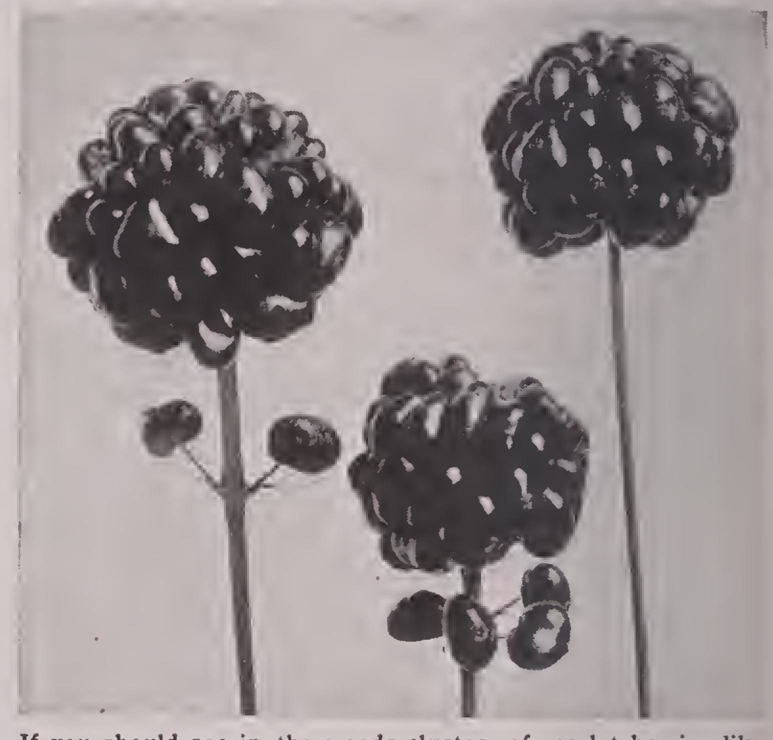
Ginger spice is made from the root-stocks of a perennial reedlike plant, similar in appearance to our iris or flagroot. Ginger is marketed in two forms, preserved or green ginger, and dried or cured ginger. China supplies practically all of the preserved ginger, which is prepared with sugar syrup or honey. For dried ginger the root is dug out after the leaves of the plant have withered. When the skin is left on it is known as "black ginger"; when it has been removed before drying, it is "white ginger." The essence of ginger used in flavoring is a tincture of ginger and alcohol.

Scientific name of common ginger plant, *Zinziber officinale*. The plant usually grows to a height of about two feet. The flowers are yellowish-white and fragrant. Another important member of the ginger family is *turmeric*, whose powdered roots are used as a yellow dyestuff, as a condiment (especially in curry powder), and in medicine.

GINKGO (*ġink'gō*). This peculiar tree, native to China and Japan, is the sole survivor of a genus once widely distributed over the world. Its fernlike leaves have given it the English name, "maidenhair tree," and the beauty of its foliage has caused its adoption as a shade tree in many sections, especially in Washington, D.C., where it is extensively planted along the streets and in the parks. The ginkgo is a graceful tree, with numerous slender branches, which form a cone-shaped head. The fruit, about the size of a small plum, has a disagreeable odor and falling makes an unsightly litter on the walks and lawn, which probably accounts for its not being more widely cultivated. The kernel of this fruit is edible and when roasted has a taste like maize; it is used as a food by the Chinese and Japanese. The ginkgo is not known in a wild state, having been preserved from extinction by its cultivation in the temple grounds of China and Japan, where it is considered a sacred tree.

GINSENG (*ġĭn'sĕng*). Many are the tales the Chinese tell of the wonderful cures that ginseng has wrought. They will tell you that its roots are a remedy for every illness, that they are able to prolong life and even to restore it after death; and their legends recount how the wolf, tiger, and snake protect this miraculous plant from harm, and how the roots save themselves from capture by moving from place to place underground. And so, although our own physicians regard it as of little value, the Chinese still buy it at any price. Many country boys keep their eyes open in summer for the three-leaved stalks and scarlet berries growing in the deeper woods, and sell the small parsnip-like roots for three or four dollars a pound.

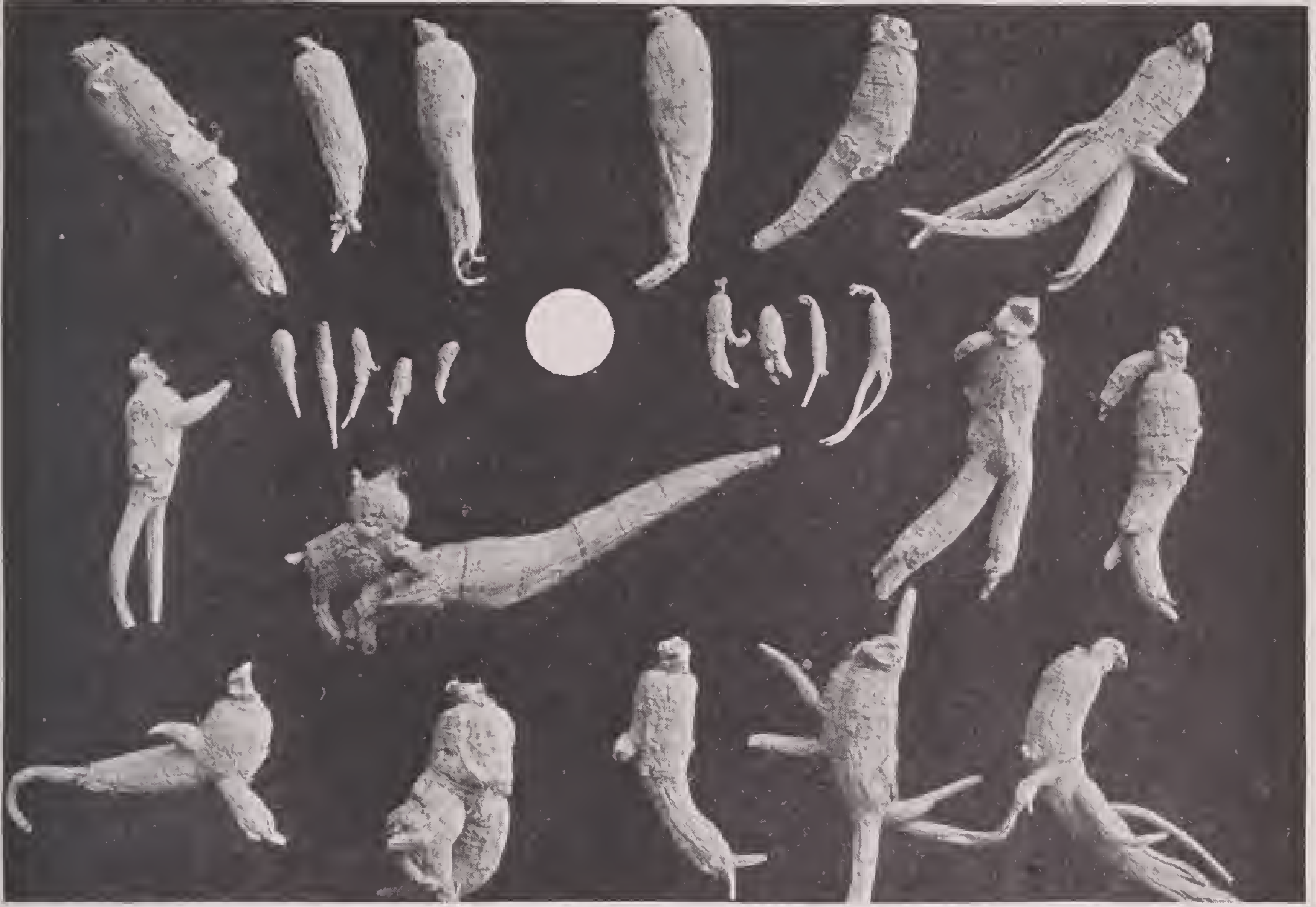
SCARLET BERRIES OF THE GINSENG



If you should see in the woods clusters of scarlet berries like these you will know that beneath them in the ground are the roots which the Chinese prize so highly as medicine.

The most valuable ginseng—sometimes worth $200 an ounce—comes from Korea or Manchuria, and an

CURIOUS SHAPES TAKEN BY GINSENG ROOTS



This ginseng is ready for market. The size of the roots is indicated by the white circle which represents the comparative size of a silver dollar. The nine smaller samples near the circle are specimens from an Oriental dealer, and show the kind of roots his trade demands. Those with "human" forms are the most valuable.

inferior quality is cultivated in Japan. It was first discovered on the American continent in Canada, and later was found to be growing in eastern United States. Most of the wild ginseng has now disappeared, and a cultivated plant is taking its place. But the wild variety always commands better prices because of the Chinese superstition which prefers roots resembling a man or some grotesque being (gin-seng means "form of man") rather than the regular roots which cultivation tends to produce.

Ginseng belongs to the genus *Panax*. *Panax ginseng*, a native of China, and *Panax quinquefolium*, of eastern North America, are the most noted species.

GIOTTO (*ġŏt'to*) (1267?-1337). An enchanting bell-tower of variegated marble piercing the skies of Florence with restrained ethereal grace, its surface adorned with beautifully pointed windows, slender columns, exquisite statues and reliefs—this is the world-famous "campanile" of Giotto di Bondone, the great Italian artist who stood at the dawn of the Renaissance. It is impossible to overestimate the beauty of this square tower of red, black, and white marble, rising in five stories over 275 feet—all of it Giotto's design and part of it (such as the first course of sculptured medallions, a wonderful series representing primitive arts and industries) actually the work of his own hand. No wonder a Florentine's expression for perfect beauty runs, "as beautiful as Giotto's tower!"

But it is as a painter and not as a sculptor or architect that Giotto is perhaps best known in the world. Born in Vespignano, a few miles north of Florence, he early showed his artistic ability. The story is told that Cimabue, "the father of painting," discovered him as a boy of 12 drawing one of his father's sheep on the ground with a pointed stone, and, attracted by his talent, made him his protégé and pupil. Soon he began to adorn church walls with wonderful "frescoes" of saints and biblical characters painted on the fresh-laid plaster—pictures that in those days served as a people's Bible. His earliest works are at Assisi, the birthplace of St. Francis, in whose church he painted some scenes in the life of that most lovable of saints. Later the pope called him to Rome, ordering a series of mosaics and paintings. These Giotto so beautifully executed that soon dukes, princes, and kings competed for his services.

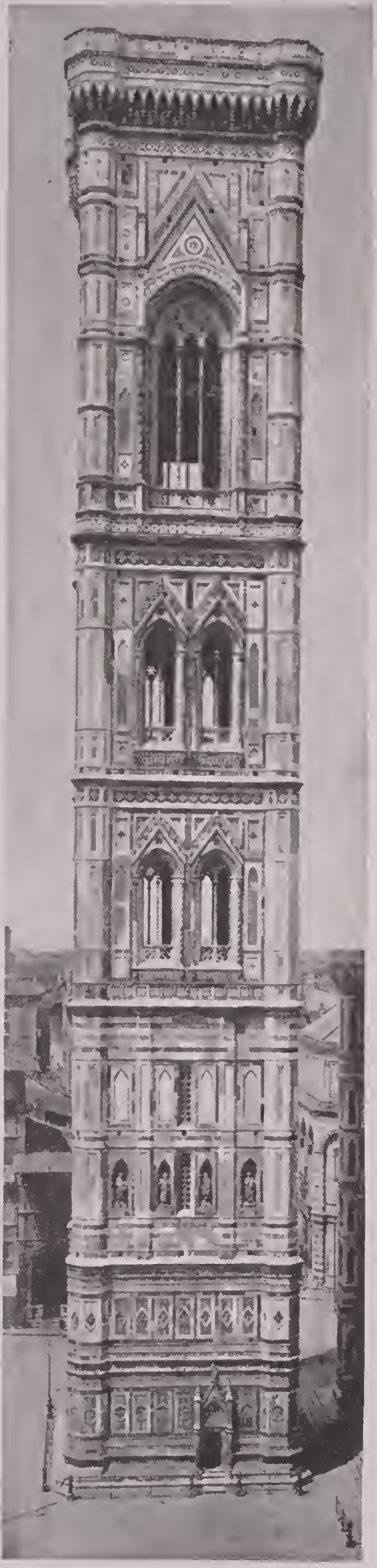
There is an oft-told story of how Giotto sent the pope a specimen of his work. "Giotto took a sheet of paper and a pencil dipped in red color, then resting his elbow on his side to form a sort of compass, with one turn of his hand he drew a circle so perfect and exact that it was a marvel to behold." Thus originated the Italian phrase, "as round as Giotto's 'O'."

Giotto's life was crowded with work. The great poet Dante was his friend and helped him choose subjects for many of his paintings. In the Palace of the Podesta at Florence is a series of Biblical scenes painted by Giotto, and among the bystanders he gives us portraits of Dante and Brunetto Latini, Dante's teacher. For centuries whitewash overlaid these frescoes, but in 1841 fragments were recovered and freely "restored." In the 38 masterly paintings of the life of Christ and the Virgin, of the Last Judgment, and other Biblical scenes which Giotto executed for the Arena Chapel in Padua he reached the supreme height of his genius. Giotto's frescoes indeed are found in almost all large Italian cities, some of the most superb being those in the Church of Santa Croce, Florence.

Giotto's last years were spent in Florence as chief architect of the Florentine Cathedral, and in working on his campanile, both of which were left unfinished at his death in 1336. He was buried in the cathedral with great honors. Over a century later Lorenzo de' Medici erected a fine monument to him with an epitaph which truthfully says: "Lo, I am Giotto—what need is there to tell of my work? Long as verse lives, my name shall endure!"

Among the most famous of Giotto's paintings are his passionate and dramatic 'Death of St. Francis' and 'Ascension of St. John', in the Church of Santa Croce, Florence; his portrait of Dante, also in Florence; his 'Christ before Caiaphas', and his simple and beautiful 'Visitation of Mary to Elizabeth', in Padua. These and others of his paintings reveal to us the simple original genius of the greatest painter Italy produced before the flowering of the Renaissance, an artist who despite his lack of knowledge of anatomy, and of technical laws of perspective, foreshortening, etc. (to which art had not yet attained), was yet the first to get away from the old conventional ideals of his time, and to paint with deep feeling and dramatic skill real people in real attitudes.

GIOTTO'S TOWER



"An enchanting bell tower of variegated marble piercing the skies of Florence, its surface adorned with beautifully pointed windows, slender columns, statues and reliefs — this is the world-famous campanile of Giotto, the great Italian artist."

GIPSIES. Have you ever, going down a country road, rounded a corner and found in a secluded spot a family of gipsies camping? Probably their covered wagon, painted with gay colors, was drawn up in a little patch of woods, with perhaps a little tent beside it. Over an open fire a young gipsy woman with liquid black eyes and very white teeth was bending, cooking something for dinner. She was dressed in full gay skirts, a fringed shawl of many colors was wrapped about her shoulders, and shining gilt bangles hung and glistened in her hair and at her throat. A lithe and swarthy man lounged by her side in a bright sash and dirty clothes, a child or two peered elfishly from the wagon at you, and an incredibly ugly old hag with withered hands like claws muttered something in a strange incomprehensible jargon. Have you seen this? And has your mother told you never to go near their camps, because gipsies steal things and kidnap children? And have you gone on your way, half fascinated and half afraid, wondering who these strange people may be, where they came from, and why they spend their lives in this way?

If you have asked yourself these questions you have done what many wise scientists have done. And if you have found no answer, they have not done much better. For the gipsies are one of the strangest problems to be found anywhere in the study of races. They live in the midst of settled civilization, yet they are not of it; they pitch their little tents in all the countries of Europe, western Asia, northern Africa, North and South America, and Australia; yet wherever they go they speak dialects of their own which vary from country to country yet always keep certain main characteristics, so that gipsies from many countries can understand one another. They have no religion of their own, most of them are unlettered and ignorant, and they know almost nothing of their own former history.

The gipsies are as distinct in physical characteristics as the Jews. In character they are boastful, quick-tempered, and quick-witted, generous

LIFE IS CAREFREE IN A GIPSY CAMP

A happy lot, aren't they, these gipsy children? This photograph was taken in a gipsy camp in England, and shows their happy-go-lucky way of living. A number of families will travel about, pitch their tents on commons near towns and villages, and earn money by horse-trading, mending cane chairs, telling fortunes, and doing odd jobs of tinkering.

to their own clan and grasping towards outsiders, fond of gaiety and bright colors, and with no very clear idea of property rights. They are wonderful musicians, playing the fiddle and the guitar with a wild charm and singing many old folksongs and ballads. The women tell fortunes and practice tricks of various kinds. Many of the men are tinkers or traveling smiths, while others are horse-traders.

The English name "gipsy" comes from an old idea, once believed almost universally, that the gipsies came from Egypt; and they themselves, apparently not knowing where they really did come from, accepted this and said they were from a mythical country called "little Egypt."

The first clear traces of the gipsies are found in the islands of the Mediterranean and in the Balkan peninsula. They appeared in Germany about 1417, and soon little bands of them had spread over all the countries of Europe. As they live by their wits, and usually at the expense of the poor people, they soon got themselves disliked, and in spite of a safe conduct given them by the Emperor Sigismund, who was also king of Hungary, attempts were made to get rid of them. At various times and places severe laws were made against them, and they were branded, tortured, and even executed. But ultimately these laws were modified, though only in rare places have the gipsies even today given up their old habits of wandering and settled down. Of the countries of Europe, Hungary, Russia, and Spain have the largest number. The total number of gipsies is estimated at 700,000. The language they speak, which is like no one European language, shows at least some resemblances to East Indian dialects. There are 14 different dialects of the "Romani chib," as they themselves call their language in Europe. These dialects are becoming more and more corrupt, mixing other words of all sorts in with the Romani words, and adopting the grammar of the country where the gipsies find themselves.

A gipsy calls himself "Rom," the man, or the husband, his wife "Romni," and his language "Romani." And it is safe to say that so long as the little tents and covered wagons roam the open country of the world, so long as the gipsy "patteran," or trails, lead over the heaths and along the roads, and the light of their fires glows at night in lonely places, "Rom" and his companions will be a source of mystery and dislike to his more settled neighbors.

GIRAFFE. If you had never seen a giraffe or a photograph of a giraffe, you might from its description be inclined to say that it was a wholly imaginary creature, out of 'Alice in Wonderland'. For no more grotesque-looking figure could be imagined than this African animal, which zoölogically is intermediate between the deer and antelopes.

The giraffe is the tallest of all living mammals, its head rising from 16 to 20 feet from the ground. This height, however, is not due to the size of its body, which is smaller than the body of the average horse, but to its exceedingly long and slender legs, and its even more extraordinary neck, which alone is often as long as the body of a tall man. When it drinks the giraffe has to straddle its legs far apart to reach the water.

You may ask, Why did Nature produce such a freak? As usual science has an answer ready. The giraffe dwells in a country where grass is scarce; its food consists of leaves. But the trees in such regions are almost bare of branches for quite a distance from the ground; therefore the giraffe has developed a long neck and long legs to enable it to browse comfortably on the tops of such trees. Its tongue is in keeping with this purpose, for it often measures a foot and a half in length.

Having produced such a strange creature, Nature also undertook to "camouflage" it for protection by giving it a spotted skin of brown and yellow. As the giraffe stands among the mimosa trees (its favorite feeding place), its skin resembles the play of light and shadow through the leaves, so that it is exceedingly difficult to detect (*see* Protective Coloration).

HE HAS THE LONGEST NECK IN THE WORLD

What an advantage the giraffe would have in a crowd! He could see over everybody's head. But his long legs and neck were not built for sightseeing, as much as to enable him to eat the foliage from trees, for he lives in a country where the grass is scarce or dried out by the intense heat, so he must dine on leaves. Can you imagine anything more awkward in appearance than this creature? Yet it can run very swiftly.

The giraffe's back slopes downward from the shoulders to the tail; and its shoulder blades project at right angles to the body so that the chest is very much wider than the rump. The neck, which has a short soft mane, is surmounted by a delicate head. Between the ears are two bony horn-like projections covered with skin and each surmounted with a tuft of bristles. In front of and between these projections is a rounded bony elevation which appears like an undeveloped third horn. In one form both males and females possess horns; but usually the horns are confined to the males. The eyes of the giraffe are described as wonderful in beauty of coloring and in expression. The upper lip is long and is used, together with the tongue, in grasping food. The hoofs are cleft and dainty in shape. The knees and hock-joints are covered by callosities like those of the camel. The hide is thick and covered with short soft hair. The nostrils are prominent and can be closed at will like those of the camel.

The movements of the giraffe are as curious as its structure. It cannot trot, but it runs in a ponderous gallop. The Arabs hunt the giraffe with their fleetest horses and yet find difficulty in overtaking it. The flesh is in great demand for food, the skin is used for leather, and the tail-tuft is used for fly-brushes.

In their native state giraffes are usually found in small herds. They chew their cud while standing erect, and wary hunters have sometimes come upon specimens leaning against trees, fast asleep.

The giraffe is entirely without a voice. No one has heard it utter a sound even when wounded. But the sense of sight and hearing are acutely developed and it is very intelligent. Although it is good-natured and gentle, it will fight in self-defense and use both head and legs as weapons. The head on its long neck can be used like a sledge-hammer to deal heavy blows. It is said that in defense of her young a female giraffe has been known to kill a lion.

Giraffes were known to the ancient Egyptians and Greeks, and many were exhibited in the old Roman games. They were thought to be a mixture of camel and leopard, and were called "camelopards"—a name which has clung to them in their scientific classification today.

The range of these animals formerly extended throughout the breadth of the African continent from the Indian Ocean to the Atlantic and in prehistoric times included even portions of Europe and Asia. But they are now confined to the plains of eastern Africa, between the Sahara desert and the valley of the Zambezi.

Until the beginning of the 20th century the giraffe was the only known member of its family, the *Giraffidae*. But in 1900 an English naturalist and explorer learned from African natives of the existence of an animal called the *okapi*, which was unknown to civilized man. A skin and two skulls of this animal were secured and sent to England for identification. It was declared to be a near relative of the giraffe, though much smaller and without the characteristic long neck of its larger brother.

GIRL SCOUTS. When Sir Robert Baden-Powell organized the first Boy Scout troops in England, in 1908, he found, in addition to the thousands of boys who were clamoring to be enrolled, at least 6,000 girls who were interested in the movement. Sir Robert therefore asked his sister, Miss Agnes Baden-Powell, to form an organization for girls similar to the Boy Scouts, to which the name Girl Guides was given. In England the movement went ahead at an amazing pace, and soon spread to Canada, Australia, and many other countries. A flourishing organization also sprang up in France known as Les Éclaireuses.

In March 1912 Miss Juliette Low enrolled in Savannah, Ga., the first patrols of Girl Guides in the United States. In 1915 the name was changed to Girl Scouts at the request of the members; and by this name the organization is also known in Hawaii, Central America, the Philippines, and the West Indies. At present there are in the United States more than 80,000 Girl Scouts and 3,600 captains. The national headquarters are in New York City.

Any girl more than ten years old may become a Girl Scout, and any group of eight girls may organize a Patrol. Several patrols are under the guidance of a captain, who directs the games and various forms of training. For the instruction of the captains national camps and training schools are established. The three grades of membership of the Girl Scouts, which are attained by passing certain tests, are known as Third Class (or Tenderfoot), Second Class, and First Class. The Girl Scout badge is a clover leaf, the three leaves representing her promises: to do her duty to God and her country; to help other people at all times; and to obey the Scout laws. These latter are similar to those of the Boy Scouts, and inculcate truth, loyalty, helpfulness, friendliness, courtesy, kindness, obedience, cheerfulness, purity, and thrift. The motto, "Be Prepared," is also the same in both organizations.

GLACIER. In many high mountains the amount of snow which falls in winter is so great that not all of it is melted in summer. Where this takes place year after year, the amount which accumulates in the upper ends of mountain valleys comes to be very great. These areas where the snow lasts from year to year are known as snow-fields. In the sunny days of summer the surface snow of a snow-field melts, and the water, sinking into the snow, freezes beneath the surface just as it does in the last snow banks of spring and helps to change the snow to ice. The weight of the snow above also compacts the snow below. By the melting and refreezing of the water, and by pressure, the larger part of the snow of a snow-field is changed into ice. Just below the snow at the top the ice is not very compact, but farther below the surface it is solid. A snow-field is therefore really an ice-field, only covered with snow.

When the snow and ice become sufficiently deep, the ice begins to creep down the slope. Ice which has this slow creeping movement down a mountain valley from a snow-field above is a "valley glacier." There are many valley glaciers in the northwestern part of the United States. There are more in Washington than in any other state, but there are a number in western Montana, where an area has been set aside as Glacier National Park. The park has been provided with stopping places, so that it is now easy for travelers to visit the glaciers. There are a few glaciers in the high mountains of Wyoming and Colorado, California, and Oregon. There are many glaciers in the mountains of western Canada, in Alaska, in the Andes Mountains of South America, in the Alps and other high mountains of Europe, as well as in other parts of the world.

There is another great type of glacier, which is not a valley glacier. When the snow and ice accumulate in quantity on a plain or a plateau, it moves out from the center in all directions. This sort of a glacier is an "ice-cap." If it is very large, it is a continental glacier. Some 300,000 or 400,000 square miles of Greenland is covered with such an ice-cap, and the area of ice around the South Pole, in Antarctica, is still larger.

Glaciers move at the rate of a few inches or a few

AT THE FOOT OF A GREAT GLACIER

This man is standing at the foot of a glacier on Mt. Rainier in the state of Washington. The picture shows a stream, formed by the melting of the glacier, running out from under the edge of the ice. Notice the cracks or crevasses that furrow the glacier's surface. In some places such crevasses form a labyrinth of yawning gulfs that baffle the skill and daring of even the best mountaineers.

feet a day. There are perhaps glaciers which move as much as 100 feet a day, but few of them move more than three or four feet. During the movement, the ice is cracked, especially where the ground over which it passes is rough. Thus arise the big cracks or "crevasses" in many glaciers. It is these crevasses which make it difficult and sometimes dangerous to cross glaciers.

As the glacier ice moves, it gathers up a great deal of rock debris and earthy matter from the surface over which it passes and carries it down the valley or towards the edge of the ice-cap. When the glacier melts, it leaves deposits of the debris. This is called "drift." In some cases there is rock debris on glaciers. If it is arranged in belts, the belts are called "moraines."

Formerly there was a huge ice-cap covering a large part of the northern half of North America, an area of some 4,000,000 square miles. Europe had an ice-cap at the same time, perhaps half as large, covering the northwestern part of that continent. The wear of the surface by the ice which passed over it and the deposition of the drift which it carried changed the surface greatly. Most of the lakes of the northern part of North America are due to the ice, which left the hollows in which the water has accumulated. The same is true of northwestern Europe.

GLACIER NATIONAL PARK. "The Alps — right here in the United States!" This is the first cry of the visitor to that mountain wonderland in northern Montana where 60 living glaciers wind in and out among chains of unscaled crags glistening with ice and snow; a place where waterfalls tumble down dizzy precipices, edged by primeval forests; where 250 lakes lie cradled among giant peaks, and where enchanted streams wander through wildflower gardens.

This public park has been called "the roof of North America," for from its mountain heights the waters divide and flow into the Gulf of Mexico, into Hudson Bay, and into the Pacific Ocean. It was once a favorite haunt of the Blackfoot Indians, but when copper was discovered there in 1890 the white man found his way to this home of the mountain sheep, and in 1896 Congress bought it from the Indians. Fourteen years later, since the copper deposits were not large enough to pay for mining, the region was turned into a national park.

Today the wilderness of about 1,450 square miles is dotted with camps, cabins, and here and there even modern hotels; so that the many tourists who flock here each year may either "rough it" or enjoy every up-to-date convenience. (*See* National Parks.)

GLADIATOR. "We who are about to die salute you!" Such was the cry with which the gladiators or professional fighters of the Roman arena saluted the Emperor as they marched about the amphitheater before engaging in combat with one another, or with wild beasts, for the entertainment of the populace. For the most part they were prisoners taken in war, slaves, or the worst classes of criminals. When a gladiator was disabled or disarmed, if the spectators turned up their thumbs the vanquished man was to be spared, but if they turned them down he was to be slain. The successful fighter was at first rewarded with a palm-branch, but in later years it became the custom to add to this rich and valuable presents and a prize of money.

The custom of giving gladiatorial shows seems to have been borrowed from the Etruscans, who sacrificed slaves and prisoners on the tombs of illustrious chieftains. The first combat in Roman history took place in 264 B.C., and the fashion rapidly spread. Julius Caesar gave a show at which 320 couples fought, and the Emperor Titus (79–81 A.D.) gave an exhibition of gladiators, wild beasts, and sea fights which lasted 100 days, in which 10,000 men fought. Such contests were finally stopped in 404 A.D., it is said, as a result of the splendid daring of Telemachus, an Asiatic monk, who rushing into the arena strove to part two gladiators. The spectators stoned him to death, but the Emperor Honorius issued an edict suppressing such exhibitions.

GLADI'OLUS. Stately in form and rich in color, the gladiolus is one of the most effective of autumn flowers. Wonderful results have been secured by scientists in creating new varieties, until there are now about 140 species of this lily-like flower, ranging in color from white and pink, through yellow, apricot, orange, and bronze, to deep rich rose and reds. The flowers grow in spikes and the best varieties are of large size, sometimes measuring 7 to 9 inches across. The plants often reach a height of 4 or 5 feet. The gladiolus belongs to the Iris family (*Iridaceae*), and most of the species are natives of South Africa. The name is the diminutive of the Latin *gladius*, a sword, from the shape of the leaves. "Sword lily" is a name frequently applied to it.

GLADSTONE, WILLIAM EWART (1809–1898). For 60 years William E. Gladstone was a member of the British Parliament. For more than half that time he was the acknowledged leader of the Liberal party. Four times he was called upon to guide the affairs of the British Empire as prime minister, and his name became associated with a great number of political and social reforms. Such a record has been equaled by few men in history, and few have exerted through the force of their characters and personality so profound an influence upon their times as this son of a Scotch merchant.

Gladstone's father conducted a large and thriving mercantile business in Liverpool, and also owned extensive coffee and sugar plantations in the West Indies. Curiously enough, it was the wealth produced on these plantations by slave labor (before the Emancipation Act of 1833) that enabled his son to devote his life to the cause of human liberty. When William was 11 years old he was sent to the famous boys' school of Eton, and from Eton he went to Oxford University, where he was graduated in 1831 with first honors in mathematics and in the Greek and Latin classics. Only once in a generation does a student

THE LAST FIGHT OF THE GLADIATORS

It was in the year 404 A.D. during the reign of the Emperor Honorius that this thrilling event took place. The gladiator with the trident and the net had just brought down his heavy-armed antagonist and was about to deliver the death blow. The crowd in the Colosseum watched breathlessly for the fatal thrust. Suddenly the aged monk Telemachus leaped into the arena, and in the name of God called upon the victor to stop. Telemachus was stoned to death by the infuriated crowd, but his brave sacrifice had its reward, for the emperor forbade gladiatorial combats from that day on.

win the distinction of a "double first" in these subjects. Deference to his father's wishes led him to give up his own inclination to become a Church of England clergyman, and to enter political life. To the end of his days he retained his interest in theology and in the classics, and in the midst of a busy political career one of his chief diversions was reading Homer in Greek and writing on Homeric subjects and on religion.

Gladstone entered the House of Commons in 1833, at the age of 24. Less than ten years later he became president of the Board of Trade and so a member of the ministry. In the beginning he was so little of a Liberal that Macaulay styled him "the rising hope of the stern unbending Tories." He first abandoned the Tories or Conservatives in 1846, when he supported the Conservative leader Sir Robert Peel against the mass of the Conservatives in repealing the "Corn Laws," so that the people in Ireland might be saved from starving. It was not until 13 years later that he definitely joined the Whig or Liberal party, of which a few years later he became leader.

WILLIAM EWART GLADSTONE
The "Grand Old Man" of British Politics

One of the spectacular feats which first brought Gladstone fame was the defeat he administered in 1852 to Benjamin Disraeli, then chancellor of the exchequer, in a fast and furious debate over the budget. With an eloquence and mastery of details which were almost unprecedented, he tore Disraeli's financial scheme to ribbons. The rivalry between Gladstone and Disraeli, who presently became the official leader of the Conservative party, lasted until Disraeli's death in 1881. (*See* Disraeli, Benjamin.)

In the course of the American Civil War, when so many of the upper classes in Great Britain sympathized with the South, Gladstone became very unpopular with the people of the Northern States because of a public address in 1862 in which he said: "We may have our own opinions about slavery; we may be for or against the South; but there is no doubt that Jefferson Davis and other leaders of the South have made an army; they are making, it appears, a navy; and they have made what is more than either, they have made a nation." This was taken to indicate that the British government, of which he was a prominent member, intended to recognize the independence of the Southern States. Years later Gladstone acknowledged that he had committed an inexcusable blunder in uttering those words. In his first period as prime minister (1868–74), he did much to heal the breach between the United States and Great Britain by agreeing (in 1870) to submit to arbitration the claims of the United States for damages growing out of the *Alabama* affair (*see* 'Alabama' Claims).

It was in his first premiership also that Gladstone began to pass his great measures of internal reform. He secured the passage of a law which for the first time gave state aid to public elementary schools. He opened the universities of Oxford and Cambridge to men of all religions. He introduced secret voting by ballot at the elections, in place of the old public method of voting.

But more than anything else, Gladstone's name is connected with his measures for Ireland. Although most of the people of that island were Catholics, the Anglican or Protestant Episcopal Church was the established church of Ireland, supported by tithes, until Gladstone passed the Irish Disestablishment Act of 1869. He also passed the first Irish Land Act (1870), which removed some of the most serious economic burdens from which the Irish peasants were suffering, and started the process by which most of the Irish tillers of the soil have been changed from rent-paying tenants to owners of the lands. Finally when Gladstone became convinced that the majority of the Irish wanted the Irish parliament restored, he introduced the first Irish Home Rule Bill. This bill (1886) was defeated in the House of Commons by the desertion of a large group of his followers who thenceforth were called Liberal Unionists; and Gladstone was forced to retire as prime minister. When a change in the elections again brought him to that position, he introduced his second Home Rule Bill (1893); this passed the House of Commons but was rejected by the House of Lords. It was then for the first time that the cry was raised to "mend or end" the House of Lords.

Gladstone's political work was now practically closed. In a short time the "Grand Old Man," now in his 85th year, retired from public life on account of approaching blindness due to cataract. His remaining years were spent at his home at Hawarden Castle in Wales. Several times he had been offered a peerage by the Queen, but refused, preferring to remain a commoner. In his long political career he had developed from a Tory to a moderate Conservative, then into a Liberal, and ended as the acknowledged leader of the Radicals. He himself once explained the changes in his political opinions in these words: "I was brought up to distrust and dislike liberty; I learned to believe in it. That is the key to all my changes."

Gladstone was most imposing in his appearance. Six feet tall, with a great breadth of shoulders, and a large head, jet-black hair (in his younger days), deep-set flashing eyes, a prominent nose, and a face of extreme pallor, he seemed to bear down from above upon his opponents. Gladstone used to say that the true secret of his success lay in his faculty of concentrating his mind upon the subject of the moment. This quality he carried even into his life at home. Often even when guests were present he would draw a pocket edition of some classic from his pocket and retire behind the book, becoming utterly unconscious of what was going on around him. Mrs. Gladstone, who had been Miss Catherine Glynne before her marriage in 1830, at times found this habit somewhat embarrassing. Yet during their long married life (Mrs. Gladstone survived her husband by two years) the atmosphere at Hawarden was ideal. One of Gladstone's habits was to sing with his wife when any adversity overtook them:

> A ragamuffin husband and a rantipoling wife,
> We'll fiddle it and scrape it through the ups and down of life.

Visitors used to come from all parts of Great Britain to watch the Grand Old Man taking exercise by chopping trees on his estate.

Gladstone served as prime minister from 1868 to 1874; from 1880 to 1885; from February to July, 1886; and from 1892 to 1894. Aside from his fame as a statesman and an orator, he received recognition from his books: 'Studies on Homer' (1858); 'Juventus Mundi' (1869); 'The Irish Question' (1886); 'Gleanings from Past Years' (8 volumes, 1879–90).

GLAND. Every day the human body produces several quarts of liquid. Whenever you cry a liquid called tears flows out between the eyelids. Even if you don't "cry," tears are produced and a drop is distributed over the front of each eye every time you wink. When you are warm a liquid called "sweat" comes out on the skin. All the time there is the liquid called saliva appearing in the mouth. Where do these liquids come from?

The answer is that they are manufactured by organs of the body called "glands." Each gland takes water and other substances out of the blood and from these manufactures its own kind of liquid, which is called a secretion. The "saliva" is the secretion of the salivary glands, located under the tongue and jaw. A tube called a duct leads from each salivary gland into the mouth.

In the wall of the stomach are many small glands which discharge their secretion through short ducts into the stomach cavity. These are called gastric glands and the secretion is called "gastric juice."

Situated near the stomach, and discharging its secretion into the intestine just below the stomach, is the liver, the largest gland in the body. Its juice or secretion is called "bile." There is a pouch, called the gall-bladder, for storing bile. The tube from the gall-bladder to the intestine is the bile duct.

Near the stomach is another large gland called the pancreas or sweetbread. It makes a secretion called "pancreatic juice," which flows through a duct into the intestine.

The Work of the Enzymes

The saliva, gastric juice, pancreatic juice, and bile are all secretions which are useful in the digestion of food. They contain substances, called ferments or "enzymes," which change complex foods into simpler substances. The saliva by means of an enzyme called "ptyalin" splits starch molecules into sugar molecules. Each digestive secretion contains its own peculiar enzymes, designed to aid in digesting particular kinds of foods.

The mammary gland secretes milk, which is not intended for the individual that produces it but for its offspring. Therefore the ducts of this gland lead to the surface of the body. This secretion contains all the food substances that the young animal will need during its infancy.

The kidneys also may be looked upon as glands. They manufacture from the blood a secretion called "urine." But in this case the liquid is composed of waste materials and is thrown out of the body. Consequently the process is generally called "excretion," instead of "secretion."

All the glands mentioned so far have ducts by which their secretion is carried either to the outside of the body or into the alimentary canal. But there are in the body certain "ductless" glands. The secretions they produce find their way into the blood and are carried all over the body. These secretions are called internal secretions or "hormones."

Among the ductless glands may be mentioned the thyroid, the parathyroid, the suprarenal, and the pituitary. The uses of all these are imperfectly understood, but it is known that they influence the activity of organs distant from themselves in the body. This is done through the circulating blood, as already stated.

The Importance of the Thyroid

The thyroid gland is located in the neck. It is known that the secretion of this gland has a wonderful influence on the utilization of food by the body. If a baby has too little thyroid secretion, it does not grow properly but becomes a peculiar idiotic dwarf known as a "cretin." In adults the lack of thyroid secretion leads to a disease called "myxedema." Too much thyroid is as bad as too little and causes a disease known as "exophthalmic goiter."

The secretion of the thyroid gland contains a substance called "thyroxin," which is a complex chemical containing iodine. The suprarenals located above the kidneys secrete a substance called "adrenalin" which keeps the blood-vessels in the right condition. Thyroxin and adrenalin are examples of the class of substances called hormones.

The pituitary is located below the brain. It is derived in early stages of development partly from the nervous system and partly from the pharnyx. Owing to this fact it has a double function. It has much to do with the proper growth of the young. It also affects muscles and some glands. Particularly it increases the secretion of urine and of milk. Diseases related to the pituitary may be due to too much or too little secretion of the gland.

The parathyroids are imbedded in the thyroid, but are quite distinct in function. Their secretion has something to do with the growth of bones.

The ductless glands are very important to the body. Removal of the pituitary, suprarenals, or parathyroids, although they weigh only a fraction of an ounce, causes death in two or three days.

Some of the ducted glands produce internal secretions in addition to those which flow out through their ducts. The pancreas is such a gland, and its internal secretion has to do with the use of sugar by the body. "Diabetes mellitus" is a disease in which the body cannot use the normal amount of sugar, and it is due to some change in the pancreas.

GLASGOW, SCOTLAND. Smoke from the giant chimneys of scores of factories; a deafening clatter from thousands of hammers pounding on cold steel; miles of shipyards lining each side of the river with forests of masts, acres of hulls, and skeletons of many vessels; and, winding in and out among nine miles of quays and docks, steamers old and new flying the flags of every nation! This is Glasgow, Scotland's industrial and maritime metropolis, which is not only one of the greatest manufacturing cities but also the shipbuilding center of the world.

"Glasgow made the Clyde and the Clyde made Glasgow" is one of the true sayings of this city. Many years ago Glasgow was only a small marshy village, but the people determined to have a port. They began to deepen, widen, and wall in their River Clyde which was then only three feet deep. The city today—which, next to London, is the largest in Great Britain—has a fine artificial harbor, costing over $40,000,000.

With its excellent connections by road, rail, and water, this commercial capital of Scotland—built right in the midst of great iron and coal fields—makes good use of its opportunities. Besides shipbuilding, and the building of all kinds of machinery, the city has important cotton mills, textile factories, calico printing and dyeing works, and distilling establishments. And its chief exports are cotton, linen, and woolen goods, machinery, coal, chemicals, paper, and whiskey. Glasgow is also the starting point for tourists who wish to visit the western Highlands. Here one finds some of the finest scenery of the British Isles, including Ben Nevis, Ben Lomond, the Trossachs, Loch Lomond, and Loch Katrine, the scene of Scott's poem 'The Lady of the Lake'.

The old part of Glasgow slopes down to the river—here called the Broomielaw—and the new part is on the higher background. Glasgow is known as one of the world's best governed municipalities. The various city improvements and undertakings are carried out by a corporation which divides itself up into a series of "trusts" with subcommittees that supervise the different departments of city administration. There are Market Trusts, Police Trusts, Improvement Trusts, etc. Glasgow's system of municipal ownership of public utilities has proved to be very efficient and economical.

Although rather dingy and smoky in appearance, Glasgow has many splendid buildings, most of them of recent erection. Its cathedral (St. Mungo's) built between 1197 and 1446, is a beautiful example of early English architecture. The massive modern buildings of the University of Glasgow (founded 1451) occupy a commanding position in the handsomest part of the city. The world-famous municipal art gallery contains the finest collection of paintings in Great Britain outside of London, including Whistler's portrait of Carlyle. Population, about 1,110,000.

THE PARTNERSHIP OF GLASGOW AND THE CLYDE

It has been said that "Glasgow made the Clyde and the Clyde made Glasgow," and this is largely true. The city made the river into a great harbor, and the harbor is the key to Glasgow's present greatness. This view shows a section of the busy river-front.

The MAGIC ART *of the* GLASS-MAKER

A Striking Example of the Chemist's Achievements and of the Mysterious Transformations Wrought by Fire—The Work of the Blower with His Big Glass Bubble

GLASS. No one knows just where or when men first found out how to make glass, but the story told by Pliny the Elder suggests how the discovery *may* have been made. In long forgotten days, according to this Roman naturalist's account, the crew of a Phoenician ship voyaging from Egypt to Syria had built a camp fire on a sandy beach of Palestine, near Mount Carmel. To prop their cooking pots they took from the ship's cargo pieces of natron, a crude form of soda, used in those days in embalming the dead. Lo! next morning in the ashes they found shapeless lumps of glass, formed by the fusing of the sand and the soda. This at least is certain, that the Egyptians and other ancient peoples had learned to manufacture vases, cups, and beads of glass at least 4,000 years ago.

In modern glass factories, the mixture is melted either in special fire-clay crucibles for the finer grades, or in large tanks built of fire-clay slabs. These tanks are rarely more than three feet deep, but are often of great extent, holding 200 tons or more of the mixture at a time. The walls of the surrounding furnace are built of nearly pure silica, for even fire-clay cannot withstand the terrific heat which is necessary to produce glass.

THE STRANGE OBJECT THE PHOENICIAN COOK PRODUCED

Of all the strange things that cooks have turned out in the course of time, none, it is safe to say, is more remarkable than the little lump of glass that, according to the old story, those Phoenician sailors found under their cooking pot on the sands. Not even Aladdin with his wonderful lamp ever produced anything half so amazing as the great industry that grew from finding this sparkling lump.

Just before the mixture of finely ground sand, soda, lime, or other ingredients is put into the crucibles or the tank, a mass of broken glass called "cullet" is added to speed the fusion. As the melting proceeds, the mixture foams and bubbles until it becomes as liquid as water. Impurities are skimmed off the surface, the mixture is allowed to cool until it is "sticky," and the work of blowing or molding begins.

Many of the larger glass factories do all the actual molding and blowing by machinery, but some of the old "mouth-blowing" still persists. Suppose the task in hand is blowing window glass. The "gatherer" dips the bell-shaped end of a five-foot blowpipe into the "soup," as he calls it, and a small ball of glass sticks to it. He puts his mouth to the other end and blows, forming a thick-skinned bubble. He dips this into the molten glass again, and blows the bubble bigger. Four or five times this is repeated, until the soft bubble has grown as big and heavy as a watermelon.

Now the pipe with its bubble passes to the "blower" who is the real expert. He puts the bubble in a molding block, and alternately blows and turns until it becomes long and pear-shaped. When the glass becomes too cold to expand readily, it is reheated in a blow furnace. Then the blower mounts a bridge built across a deep "swing hole." He swings the pipe with its hanging mass of glass back and forth, blowing all the while, until it is drawn out into a long cylinder with thin even sides. When this has cooled the ends are cut off by wrapping a hot glass thread around them and touching this with a cold iron. Immediately a crack runs around the cylinder in the path of the thread.

The open cylinder is now laid in a cradle; a hot iron is drawn down one side in a straight line; a cold iron touches this line; and the cylinder is split lengthwise as neatly as you would cut a sheet of paper with scissors. Finally the sheet is heated and flattened, and stored to be cut into window panes.

The compressed-air machine blowers perform the same tasks as the mouth blower, but they handle much larger quantities of glass and produce much longer and broader cylinders. Bottles are now generally blown into molds by automatic machines, some of which turn out 50,000 a day.

In making plate glass, the molten glass is dipped up from the tanks in big pots attached to cranes and poured out upon large iron tables, which have adjustable rims as high as the desired thickness of the glass. There it is rolled out smooth, like dough under a rolling pin. The coarser grade, used in skylights, is then ready for final cooling. The finer grades, for shop windows, mirrors, etc., are carefully ground under iron blocks, then polished with felt and a powdered oxide of iron called "rouge." Thus glass is obtained which is uniform in thickness and does not distort the view as does ordinary window glass.

The "blanks" from which cut-glass articles are made are first pressed into shape in molds. The patterns are then marked on with chalk, ground out with sand and emery wheels, and the ground surfaces polished with putty powder. In the cheaper grades, the pattern is pressed into the glass in the original mold. The edges are then ground sharp and the surfaces polished until it is almost impossible to distinguish between the two grades either in their appearance or quality.

"Wire" and "Frosted" Glass

"Wire glass" is made like plate glass, except that the heated wire screen is pressed into the middle of it while the glass is still soft. "Ground" and "frosted" glass is produced by making one of the surfaces rough, so that, although light passes through, it is so diffused that the details of objects are not visible. Glass is "etched" by being covered with a thin coating of wax, through which a pattern is scratched; hydrofluoric acid, one of the few chemicals which will actively attack glass, is then allowed to eat through the places where the wax is scratched away.

Though glass appears under most conditions very rigid and brittle, it can be drawn into strands almost as fine as a spider's thread and nearly as flexible as silk. Such "spun glass" is usually made by melting the end of a glass rod; drawing out a thread from it as you would draw taffy; and fastening the end of this thread to the rim of a large wheel. While the rod is held in the flame to keep the glass soft, the wheel is revolved rapidly, drawing out the fine thread and winding it up at the same time. The bright golden hair of many of the best china dolls is spun glass; and cloth can be woven from it. "Mineral wool" is a similar form of glass fiber produced by turning compressed air or steam upon molten glass. It is used as a heat preserver around boilers and steam pipes, as a filter in chemical operations, and as a polishing fiber for gold and silver.

Clear and Colored Glass

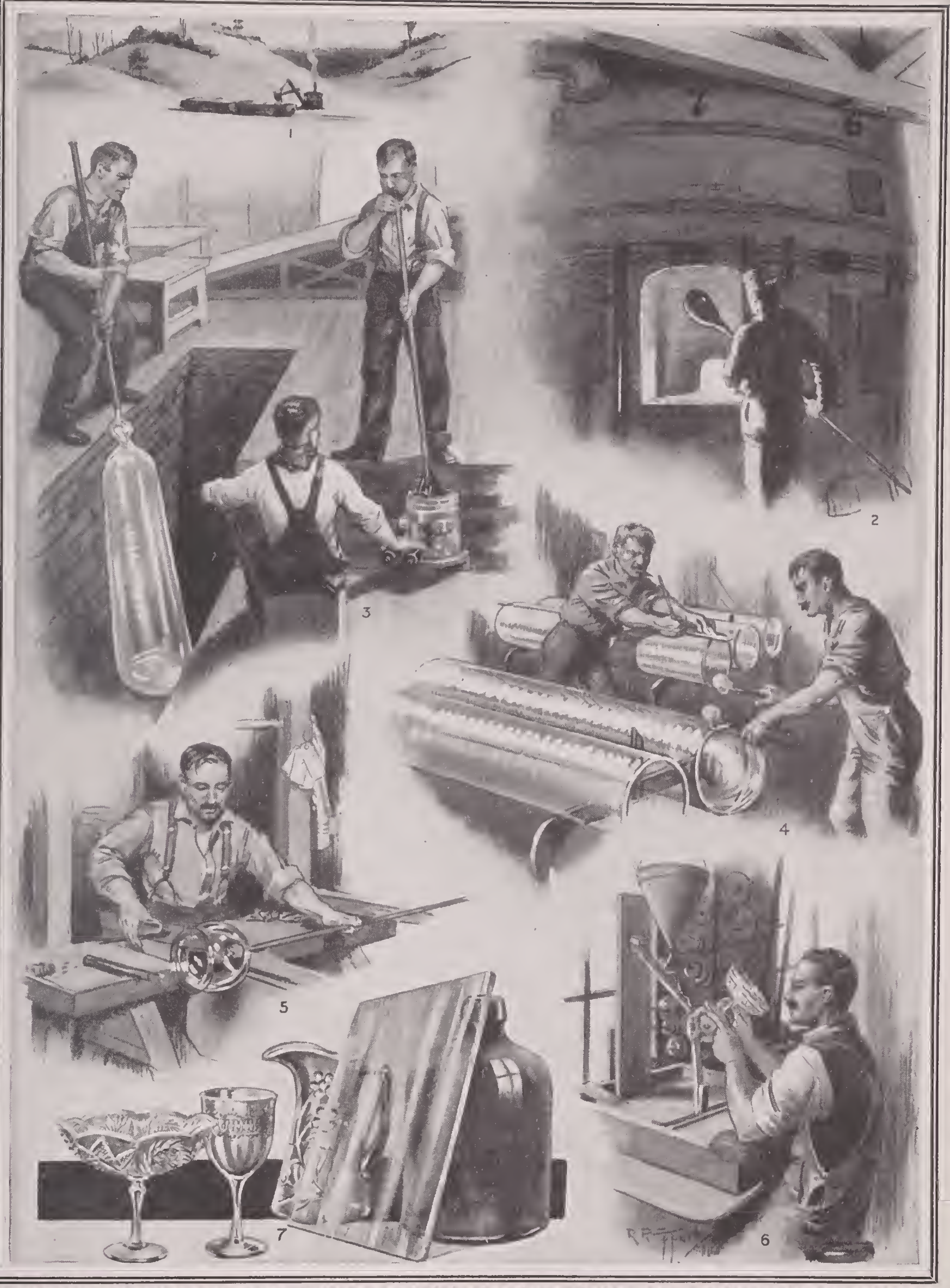
Colored glass is made by adding small amounts of various metallic oxides to the usual material. Chromium gives green shades, manganese shades from pink to purple; copper yields reds and blacks; uranium, yellows and greens; cobalt, a great variety of blues. The best "ruby" glass is made by adding a tiny quantity of gold, which is held in suspension in the form of a powder so fine that it can be seen only with the ultra-microscope. To reduce the expense only a thin coating of ruby glass usually is applied to the surface of a sheet of clear glass.

Even plain clear glass varies greatly in its composition, and its properties depend upon the "base" chosen to mix with the silicate, as well as upon the treatment it receives in the making. For example, lead and barium give weight and brilliancy and increase the softness during the manufacture. Magnesium and aluminum give a glass which stands red heat without softening. "Crown glass," which contains soda, has a very brilliant surface; it derives its name from the process of blowing. "Flint glass," also called "crystal glass," contained lead, but received its name from the fact that its silica was obtained from powdered flints; the term is now applied to almost any transparent colorless glass.

The most difficult tasks of the maker of fine glass are, first, to obtain pure chemicals and mix them in the proper proportions, and second, to temper or anneal his glass properly, when it is cooling. Glass mixtures are extraordinarily sensitive to changes in chemical composition. A minute quantity of iron, for instance, in a big "batch" of plate glass may discolor it all, and once the mixture is melted, there is no way of removing the offending chemicals; the whole mass must be thrown away or used for some inferior purpose. Or perhaps the maker of "flint" glass has put in an extra quantity of the lead oxide which gives it its brilliancy, and several months later the cut glass bowl he has fashioned tarnishes to a dull and dirty hue.

Even if the mixture is exactly right and the article is blown or molded to its proper shape, the whole may be spoiled by allowing it to cool too quickly. Glass as you know is an extremely poor conductor of heat, and when boiling water is poured in a tumbler it cracks. This is because the inside gets hot and expands quickly while the outside remains cold and contracted. Some

SCENES IN THE STORY OF GLASS-MAKING



1. Loading the sand used in glass-making. 2. Gathering a ball of molten glass on the blow-pipe. 3. Reheating the glass and blowing a cylinder over the "pit." 4. Cutting cylinders. 5. Finishing a fish globe. 6. Glass cutter at work. 7. Cut glass, plate glass, and an ordinary glass bottle.

fine grades of glass are cooled over a period of many weeks to give them the proper temper. Certain "low expansion" glasses have been produced which may be plunged while almost red hot into cold water without cracking. These are valuable for baking dishes, chemical apparatus, water-gages in steam boilers, and many other purposes.

It is in making the high grades of optical glass that the most careful science is called into play. Certain chemicals, principally compounds of barium, boron, magnesium, lithium, and phosphorus, when added to the ordinary ingredients alter profoundly the effect of the glass upon the light rays that pass through it. For generations scientists who used microscopes, telescopes, photographic apparatus, etc., had been handicapped by the optical defects of lenses made with ordinary flint and crown glass. In 1881, however, two physicists began in the city of Jena, Germany, a series of experiments which resulted in the production of about 2,000 new kinds of glass, more than 70 of which have proved of immense value in lens-making. The others are prized for their colors, their toughness, their resistance to heat, etc. During the World War, when the supply of Jena optical glass was cut off, other countries, including the United States, made great strides in the domestic production of optical glass for telescopes, field glasses, periscopes, and similar instruments. France outstripped all other countries in the making of artistic glassware. American inventors have developed the mechanical side of the industry, producing machinery which greatly aids the manufacture. Pennsylvania leads in the United States in the production of glass for general purposes. Next in rank are Ohio, Indiana, West Virginia, Illinois, New Jersey, and New York. Cheap fuel (especially natural gas) and a plentiful supply of the right kind of sand near at hand are essential for a successful glass factory.

GLASS AND SUBMARINE BOTANY

One of the most interesting uses of glass is in making museum models of plants. This picture shows a group of sea plants in the New York State Museum at Albany. Glass is used because it can be made to reproduce exactly the translucent colors of marine vegetation.

Not the least of the glories of the Gothic cathedrals with which the Middle Ages enriched Europe were the vast stained glass windows whose storied radiance flooded the dark interiors with brilliant color. In large part the art which produced them is now lost to the world, though America has made some notable progress in its revival.

In producing such a pictured window, the artist worked out his design by means of a "mosaic" of bits of colored glass set in outlines of lead. The delicate shadings of draperies, the lines of the figures, etc., were produced by painting the surfaces with colors made from metallic oxides mixed with oil of turpentine. Finally the colors were fixed by firing—that is, the glass was placed in an oven, and the pigments were fused into the glass by heat, so that the coloring was made both transparent and permanent.

From Egypt the knowledge of glass-making spread to neighboring lands of the Mediterranean. It was introduced among the Romans about the beginning of the empire though glass had long been imported. As the art declined in Rome with the decay of the empire, it was transferred to Constantinople, where it flourished during the Middle Ages. The Arabs obtained a knowledge of glass-making, and the glass of Damascus was widely celebrated. Venetian glass also early became famous, and mirrors, goblets, and cups from Venice were sent all over the known world. The first attempt at the manufacture in the United States was at Jamestown, Va., in 1608.

GLOVES. Kid, silk, lisle, and cashmere gloves for dress and leisure wear; buckskin and dogskin for riding, driving, and heavy uses; rubber gloves for surgery, electrical work, and housework; cheap cloth gloves for any rough task—there are gloves for every use and every occasion. But the two main classes are leather and fabric gloves.

Leather gloves are made of skins of deer, sheep, lamb, goats, and kids, but the name of the glove does not always tell the animal from which it came. While French kid is considered the finest glove material, more "kid," "doeskin," and "buckskin" gloves are made of lambskin than of kidskin or deerskin. "Chamois" gloves, too, are made from the inner layer of split sheepskin or lambskin, tanned with fish oil to make the material washable. The so-called English "dogskin" or "Cape" gloves are made from the skins of sheep grown at the Cape of Good Hope; American tanners, improving on the English process, make washable Cape leather. "Mocha" gloves are made from Arabian sheepskins, first shipped, it is said, from the port of Mocha which gives its name to Mocha coffee. The mocha finish, producing a leather much like "suède" or undressed kid in appearance, but stronger, is an American invention; it is produced by "buffing" or "friezing" the smooth surface from the hair side, whereas suède is finished on the flesh side. It should be noted that the finest grades of wool usually grow on skins which are much inferior to those which produce heavy wiry wool. The best skins for gloves used to come from Russia; other varying grades come from Spain and eastern Europe.

The dried skins, when received, are soaked and softened in limewater for two or three weeks, cleaned of hair and flesh, cured by the process necessary for the particular kind of glove desired—for example, skins for kid gloves are "tawed" in a custard of alum, eggs, flour, and salt—dyed, and given the desired finish. The "glacé" finish is produced by sizing the grain or hair side.

The prepared skins are next divided into "tranks" or slips, and each trank is cut by machine-operated dies into a glove ready for sewing, the scraps being used in making the strips for the inner sides of the fingers, etc. Fine dress gloves are sewed over and over ("overseam" or "roundseam"); heavier walking gloves may have one edge lapped over the other (*pique*); very heavy gloves have the edges brought together like an overseam but are sewn through and through ("prickseam" or "saddlers' seam"). Machines for sewing gloves were invented scarcely 50 years ago; though they were long fought by many of the best manufacturers, most gloves on the market are now machine sewn.

Fabric gloves may be made of silk, lisle, cotton, or cashmere or other wool yarn. They may be knitted without seams, or stamped out of a fabric knitted with a special stitch which does not ravel when cut. They are cut and sewed somewhat as are leather gloves, but in larger sizes, being shrunk to the proper size after cutting. Knitted gloves and mittens are made in a number of hosiery mills.

In spite of the introduction of machinery, leather glove-making continues to be a highly skilled occupation, which thrives best in communities long devoted to it. French gloves have long had a high reputation, and the finest French gloves have come for centuries from Grenoble, Paris, Niort, and Vendôme. Copenhagen and Brussels are other continental glove-making centers. The great English glove center is Worcester. In the United States the industry is carried on chiefly in Fulton County, N.Y., especially in the towns of Gloversville and Johnstown, where it has existed since Sir William Johnson in 1760 brought over some glovemakers from Perthshire, Scotland (the "Fair Maid of Perth," you remember, was a glover's daughter). Although the importance of the industry and the production of fine gloves are of comparatively recent date in the United States, gloves of the finest quality are now made.

GLOWWORM. A beetle native to Europe, the female of which is wingless, somewhat wormlike, and possesses a "lantern" on its abdomen with which it signals to the flying male. It is rarely found in America, but is a widespread European and Siberian insect. (*See* Fireflies and Glowworms.)

GLUCOSE. Out of every 100 pounds of the whole corn crop of the United States, one pound is converted into glucose, or "corn syrup." Glucose is a very thick liquid, usually light amber in color, and about two-thirds as sweet as sugar cane syrup. Many plants transform starch into glucose, and honey consists largely of glucose which the bees have collected.

Since glucose does not readily crystallize, it is especially useful in preserving and canning. Cheaper grades of candies are nearly all glucose, and even the best grades usually contain a certain percentage of glucose to keep the sugar from graining. Mixed with about 15 per cent of cane syrup it is widely used for the table. Scientists once argued over the wholesomeness of glucose, but food experts of the government have repeatedly declared that it is in no way injurious to health. It requires practically no digestion, being absorbed by the blood directly from the intestines, and is then burned by the tissues to furnish heat and energy.

Glucose is made by treating starch with very dilute sulphuric acid. The starch is said to be "hydrolyzed" and is converted chiefly into glucose. Chalk or caustic soda is added to remove the acid, and the liquid is filtered, decolorized by passing through bone-black, and evaporated in vacuum-pans to the desired consistency. If the evaporation is continued until a great deal of the water is eliminated, the product is chiefly *grape-sugar* or *dextrose,* a mass of tiny white crystals surrounded by syrup. (*See* Sugar.)

GLUE. In making glue the hoofs, horns, bones, and sinews of animals are crushed and the fat is extracted with hot naphtha. The materials are then boiled in water under steam pressure until the glue, which is an impure gelatine, oozes out. This is clarified with potassium alum, concentrated in vacuum pans at low temperatures, bleached with sulphur dioxide, and run into pans to "set." It is then cut into thin slices and dried. Some glue is prepared from clippings of hides, which are steeped in lime to remove the hair and blood, washed and dried, and then boiled with water. Fish glue is a very strong and bad-smelling adhesive made from fish skins, bladders, and other fish offals.

Glue is prepared for use by melting in pots set in hot water. Liquid glue is kept fluid by adding an acid. Elastic glue, used in making printers' rollers and for other purposes, contains glycerin. The sizing which paper-hangers put on plastering before pasting on wall paper is a thin solution of glue and water.

The glue industry in the United States was founded by Peter Cooper in 1827. Today most glue factories are operated in connection with meat-packing houses.

GLYCERIN. A chemist would call glycerin (or glycerol, as he terms it) a tri-hydric alcohol; but in spite of this formidable name it is a very common and a very useful substance, without intoxicating properties. It is found combined with fatty acids in all true fats and oils (not mineral oils). It is found free in palm oil, and as it is a product of alcoholic fermentation of sugar it occurs in such fermented liquors as wine and beer, although to a slight extent. Much glycerin is obtained as a by-product in the manufacture of soap (*see* Soap). The fat or oil is treated with alkali, and the products are soap and glycerin. The glycerin is then distilled off and further purified. If beef fat or other fat rich in stearin (a combination of glycerin and stearic acid) is treated with superheated steam, the stearin is split into glycerin and free stearic acid, a hard waxy substance which is mixed with paraffin to make candles.

Pure glycerin is a colorless odorless syrup. It is very sweet (hence the name, from the Greek *glykys*, "sweet"); it is heavier than water, and will mix in all proportions with water, and yet it will burn. Glycerin will dissolve many substances and large quantities are used in toilet preparations, such as soaps, face creams, and washes. It is also used in gas meters and other mechanical appliances in which a liquid is needed which will not readily freeze at winter temperatures or evaporate in summer.

The largest use of glycerin, however, is for making nitroglycerin, dynamite, blasting gelatin, and smokeless powders. The great scarcity of fats in Germany during the World War was largely due to the amount of fats used for the manufacture of these explosives for military purposes.

GNAT. Any of the very small two-winged insects are commonly called gnats, but the name is not a scientific term. Some of the insects which are called gnats are the smaller mosquitoes, midges, buffalo gnats, and gall gnats. The true mosquitoes can be told by the fringelike scales on their wings, and because their young always grow in the water.

GOAT. Though the name of the useful goat has long been a synonym for evil, it is far from deserving its ill reputation. No domestic animal is more widely distributed and none has been of greater service to man. It gives edible nutritious meat and wholesome milk; fine leather is made from its hide, and an exceptionally strong durable cloth from its hair; and, most important of all, it is extremely hardy and can grow fat on coarse vegetation on which other animals would starve. Part of the goat's evil reputation doubtless comes from the strong odor and surly temper of the males, and from the frequently acrid taste of the flesh and milk. In America it is little used for food, but some people prefer its milk and flesh to that of the cow.

Goats are closely allied to sheep, but are distinguished by the beard on the chin of the males. Wild goats are found only in Europe, northern Africa, and the Himalaya Mountains. Of the ten species the ibex is the most interesting (*see* Ibex). The Rocky Mountain goat of North America is an antelope and not a goat (*see* Antelope).

A SWISS BOY AND HIS GOAT

Switzerland is one of the places where goat's milk and goat's flesh are popular. This picture shows a Swiss boy feeding some tempting morsel to one of his pets. Notice the bell tied around the goat's neck so that the sound will always show where to find it.

Domesticated goats (*Capra hircus*), which are thought to be descended from the wild goat of Persia, have been bred in many parts of the world from the earliest times. The Angora goat, native to Angora, in Asia Minor, has a history that may be traced back to the days of Abraham. This type has long spiral horns, and an abundance of long white silky hair, from which a strong cloth is made, called mohair. It is extensively bred in Turkey, South Africa, and to a smaller extent in the United States. Brushwood forms one of its favorite articles of diet and so herds of Angoras are much used for clearing brushland. The flesh of this species is edible at all ages and is often sold as mutton.

Milch goats are found in all European and Asiatic countries, the Toggenburg and Saanen breeds of Switzerland being the best. Because of the wholesomeness of goat's milk, especially for invalids and sickly children, the number of milch goats in the United States has greatly increased. When its size is considered, a good goat is a larger producer of milk than the cow, and it costs much less to keep one. It is for the latter reason that the goat is sometimes styled "the poor man's cow." The highly prized Swiss cheese is made from goat's milk.

Cashmere (India) and Tibet are the home of the Cashmere goat, from whose beautifully soft silky under-coat are made the famous Cashmere shawls. Attempts to introduce this breed in the United States have been unsuccessful. These Cashmere shawls are exceedingly costly, for it takes the fleece of ten goats to make one shawl a yard and a half square, and the weaving, which is all done by hand, takes about a year. Some especially beautiful patterns have been sold for as much as $1,500.

GEORGE W. GOETHALS
Master Engineer of the Panama Canal.

The hides of young kids are used extensively for gloves and shoes, though much of the so-called kid-leather is an imitation, made from the skins of rats and dogs. The skin of the Angora, with the hair intact, is often used for rugs and robes. Goat-skins are also used in the manufacture of shoes, music rolls, morocco for book bindings, and other articles. So great is the demand that more than $30,000,000 worth are imported into the United States every year.

GOETHALS (*ḡō'thäls*), GEN. GEORGE WASHINGTON (1858–). Imagine yourself in jungle-clad Panama during the construction of Uncle Sam's canal. It is only 7:00 a.m., but Colonel Goethals of the United States Army, appointed "boss of the big job" in 1907, is already off in a little yellow car, called by the canal workmen the "brain wagon." Tall and gray, with bronzed face and blue eyes, he drops off now and then to watch men digging or blasting. A word here, a question there, and on he goes, "always on the job."

The direction of the greatest engineering task in history required not only a master engineer, but a true organizer and commander of men. With a genius for detail, Colonel Goethals organized the labor army of 40,000 into a model of smooth-running efficiency and industrial contentment. Though he was equipped with the power of a Russian czar, no humble dark-skinned laborer but could go to him personally. A man of force and resources, strong in personality and able to inspire confidence and energy in others, he brought the canal to completion in 1914, nearly a year ahead of schedule.

"Peace hath her victories, no less renowned than war." Goethals proved himself a hero-soldier of peace. Indeed, his peace victory in Panama was even vaster in its effect on the destiny of nations than many a military triumph.

Experience had fitted him for the great undertaking. Born in Brooklyn, N.Y., he was graduated from West Point in 1880, second in his class. His rise in the army through the lower grades was slow, but he was made captain in 1891. He taught military engineering at West Point (1885–87); was chief engineer of volunteers in the Spanish-American War (1898); was for a time a member of the Board of Fortifications; and had taken the advanced course in the War College (1905) before his engineering opportunity came at Panama.

After the completion of the canal Goethals was made major-general and appointed first civil governor of the Canal Zone (1914–16). After the United States entered the World War he was made acting quartermaster-general of the army, and filled many other posts of importance in that trying time. After retiring from the army in 1919 he became a member of an engineering firm to engage in reconstruction work in America and Europe. Princeton University and the University of Pennsylvania both honored him with the degree LL.D. In addition to special thanks from Congress for his work in Panama and the Distinguished Service Medal for his services in the Quartermasters' Department, the French government made him a commander in the Legion of Honor. (*See* Panama Canal.)

GOETHE (*ḡû'tĕ*), JOHANN WOLFGANG (1749–1832). Goethe, the great German poet, once said that he "lived" his poems and that they made up "a great confession." He meant that he found life so interesting, and even small happenings so full of meaning that when he had caught the secret of the interest or had come to understand the meaning, his joy or sorrow had turned into something that became a poem or a story. His zest for life and his lively imagination he inherited from his mother. She was only 18 when he was born and she once said, "My Wolf and I were children together." From his father, however, he inherited a certain sedateness and steadiness. So he was always making the most of life and getting the most out of it, yet never letting himself go or losing his grip on himself. He seemed always to find the golden mean in life. Thus in what he wrote there is a great deal of wisdom as well as beauty and charm.

Goethe's greatest work, 'Faust', a dramatic poem in two parts, is in a special sense the "confession" of his whole life. From early youth, when he learned the story of Dr. Faustus from a puppet play, until he penned the last scene shortly before his death, there was scarcely a period of his life that Faust was entirely out of his mind, scarcely a period that did not add something to the great work that was growing under the poet's hands. Faust desires all knowledge, to squeeze the lemon of life dry. Unsatisfied by the results of his studies, he turns to magic. He conjures up the devil in the shape of Mephistopheles and makes an agreement with him. In Goethe's 'Faust', Mephistopheles must gratify Faust's every wish; if he can satisfy Faust, Faust's soul is to belong to Mephistopheles. Faust learns that pleasures are not happiness. His wishes become purer and reach their highest point in a grand project that is to benefit others. The moral height he has reached calls the powers of Heaven to his aid and in response they wrest his soul from the clutches of Mephistopheles. (*See* Faust Legends.)

THE BIRTHPLACE OF GENIUS

In this picturesque house in Frankfort-on-the-Main, Goethe was born in 1749, and here he spent his boyhood. Frankfort was a progressive city and stimulated the genius of its most famous son.

Goethe's other great work was his novel 'Wilhelm Meister'. This work, too, Goethe wrote at various times, changing the plan from time to time. But through it all Wilhelm Meister is seeing life and learning in the school of experience. Life is the best teacher, Goethe thought. He wanted the fulness of life for himself, and he tried to show others how to live fully.

Goethe's long life was, indeed, a full life. His boyhood was spent in Frankfort-on-the-Main, which was in the cross-currents of the history that was then making. A boy like Goethe could not help but be stirred by the happenings around him, even though they did not directly affect the course of his life. He was taught at home by his father, together with his only sister Cornelia, a child scarcely less gifted than himself. Both excelled in literary exercises. Wolfgang wrote his first dramas for a puppet theater which his grandmother had given him.

From Frankfort he went to the University of Leipzig and from there to the University of Strasbourg. At Strasbourg he met the critic Herder, who directed his attention to Shakespeare and to folk poetry (the ballads and songs that seem to have no author and live only in the recitation and singing of the common people). Such literature offered more naturalness and warmth and real life than was to be found in 18th-century poetry. The songs Goethe now wrote were indeed marked by greater naturalness and truth to life, and made the beginning of a new and great era in German literature. His first drama of note, 'Goetz von Berlichingen with the Iron Hand', is the story of a staunch but lawless baron of the 16th century, and shows the influence of Shakespeare. A translation of it influenced Sir Walter Scott to write 'Marmion' and 'The Lady of the Lake', "with all that followed from the same creative hand." Many others were similarly influenced.

Goethe won the friendship of the Duke of Saxe-Weimar, a ruling prince of Germany, who made him a councilor of state at Weimar. Goethe took his duties seriously. He gave particular attention to developing the agriculture, forestry, and mining of the duchy, and thus began his studies in the natural sciences, in the course of which he foreshadowed the Darwinian theory of evolution. Later he was, for 22 years, the director of the duke's court theater. Other great men were also attracted to Weimar, notably Herder, Wieland, and Schiller, and Weimar thus became the intellectual center of Germany.

In 1786–88 Goethe made a journey to Italy, drawn there by his interest in Greek and Roman art. He himself regarded this first visit to Italy as the turning point in his life. He saw that the "natural" expression in poetry had gone too far (though he had not carried it too far in his own works), and his experience in Italy gave him a broader and sounder view of literature, art, and life. Goethe might always be trusted to find something to steady him, even in circumstances that swept others off their feet. The Greek spirit of measured beauty is found in Goethe's play 'Iphigenie at Tauris', and in the delightful little epic of 'Hermann and Dorothea'.

Goethe's friendship with Schiller, the best loved of German poets, is one of the famous literary friendships of history. It was helpful to both. It gave Goethe new inspiration, and a surer guidance to Schiller's somewhat too impetuous genius. The death of Schiller in 1805 was deeply mourned by Goethe. The friendship is commemorated in Weimar by a statue of the two poets standing with hands clasped.

Goethe was a remarkably handsome man. A bust of him in the ducal library at Weimar represents him as Apollo. Goethe also impressed those who met him by the splendor of his mind and his distinction of manner. Napoleon, after meeting him, exclaimed, "Voilà un homme!" ("There is a man!") There have been greater men and greater writers, but few have been so great both as men and as writers.

Goethe's chief works, in addition to his prose writings and songs, odes, etc., were: 'Goetz von Berlichingen' (1773); 'Werthers Leiden' (Sorrows of Werther), 1774; 'Iphigenie auf Tauris' (1787); 'Egmont' (1788); 'Torquato Tasso' (1790); 'Reineke Fuchs' (Reynard the Fox), 1793; 'Wilhelm Meisters Lehrjahre' (Wilhelm Meister's Apprenticeship), 1796; 'Hermann und Dorothea' (1797); 'Aus meinen Leben: Dichtung und Wahrheit' (1811, 1812, 1814, 1833, autobiography); 'Faust', complete (1831).

The METAL *that Measures the* WORLD'S WEALTH

FOR gold men have toiled and died; wars have been waged for it, and it has inspired crimes of the deepest dye. "To what dost thou not compel the minds of mortals, accursed greed for gold?" indignantly asked the Roman poet Vergil. On the other hand, the search for gold has been one of the most important motives in the spread of civilization. The "pot of gold at the end of the rainbow" has been the reward for which men have braved the terrors of unknown lands, and the prospector has blazed the trail for the settler to follow. The Spaniards who conquered Mexico and South America were seeking gold; it was the gold rush of '49 that started the settlement and development of the Pacific coast; and the first important start of Australia toward greatness followed the discovery of gold in 1851. Similarly the discoveries of gold in Alaska and South Africa were great factors in the development of those countries.

GOLD. Although gold is widely distributed over the earth, it occurs mostly in such small quantities that it cannot be profitably extracted. It is even found in minute quantities in sea water. Despite the fact that gold has been mined from remote antiquity, the amounts recovered have been so small and have required such expenditure of time and labor that it remained the most precious of metals until the discovery of a few even rarer metals in recent times. The total world production of gold, from the discovery of America to 1916, is estimated at about 16½ billions of dollars, weighing about 20,500 tons—enough to make a circular tower of gold 20 feet in diameter and 138 feet high.

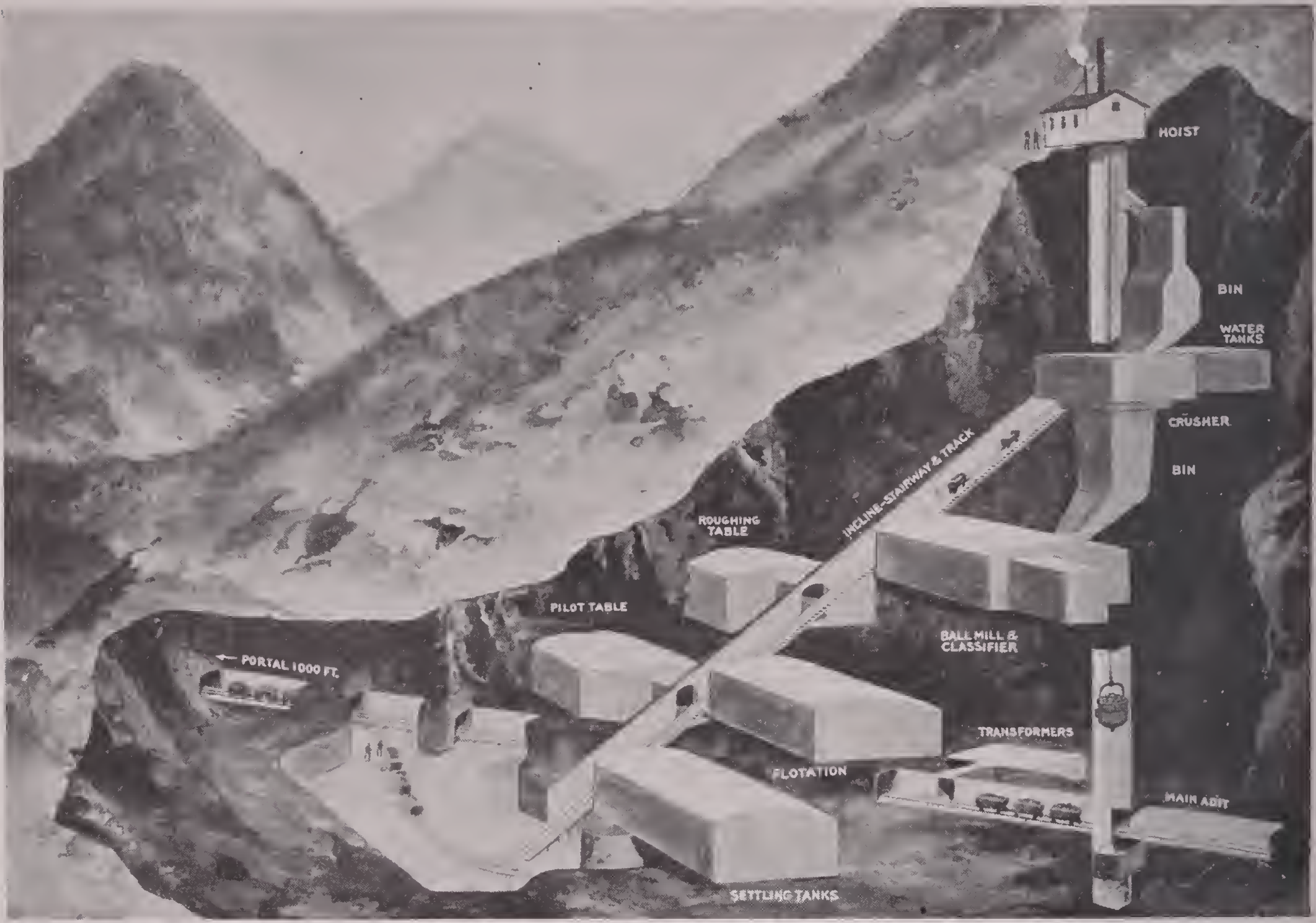
Most of the gold mined in the earlier days was produced in the Spanish Peninsula, Greece, Asia Minor, India, and the Ural Mountains of Russia. After the discovery of the New World, great supplies were obtained from Central and South America, but the total production from that time to the discovery of the California gold fields was less than the average annual production today. An enormous jump in production resulted from the discovery of the California deposits (1848) and other great fields, the most important of which are, with dates of discovery: Australia (1851); British Columbia (1858); New Zealand (1858); British India (1884); Witwatersrand, South Africa (1886); Alaska (1897).

The greatest gold-producing region today is the Witwatersrand district of South Africa. Johannesburg is the largest gold-mining center with an output which some years has exceeded $150,000,000. The United States, including Alaska, ranks next to South Africa in production, with California first, Colorado second, and Alaska third. Until the World War Russia produced twice as much gold as all South America. The Mysore mines in India have been big producers and have shafts more than 4,000 feet deep. The deepest gold mine in the world is the Morro Velho, Brazil, 6,126 feet deep.

Gold is found both native—that is, uncombined with other minerals—and in combination with various other elements. Native gold occurs in rocks, in many cases in quartz veins, and some iron pyrites. It also is found in some sands and in beds of gravel deposited by rivers.

There are two principal methods of mining gold: (1) "placer" mining for alluvial deposits, and (2) "lode" or "quartz" mining, where the gold is in solid rock. Placer mining was known in ancient times. Gold washing as early as 4,000 B.C. is shown in pictorial rock carvings in Egypt. The legend of the Golden Fleece may have been suggested by the use of fleeces to catch gold in ditches and flumes. In placer mining nature has already done the greater part of the work. In the process of wearing down the "eternal hills" by erosion, gold, being one of the heaviest of minerals (19.27 times as heavy as water), naturally goes to the bottom of streams. There it is deposited in the form of scales or nuggets, for the most part in the same shape in which it was originally held in the rock. The size of the particles varies from fine powder (gold dust) to the great Australian "Welcome stranger" nugget, weighing 2,520 ounces —the weight of a medium-sized man. The separation of gold from the gravel and sand is accomplished on the same principle that has been in operation

A GOLD MILL FORCED UNDERGROUND BY SNOW



A mining company in the mountains of Ouray County, Colorado, devised this scheme to escape the snow slides which were constantly destroying their property. The plan shows all the parts of the mill tunnelled out and excavated beneath the surface of the hill. All that is visible above ground is the small hoist-shed.

through the agencies of nature. Masses of the gold-bearing gravel are stirred up with water and the heavy gold sinks to the bottom. This is done on a small scale in a prospector's pan, and on a large scale in sluices. In hydraulic mining, great beds of gravel are washed out by streams of water conducted through pipes like a fire hose. These jets are so powerful that men and animals have been killed by them at a distance of 200 feet from the nozzle. Gold dredging is also carried on by means of flat-bottomed boats with devices to dig gravel from the bed of the stream or from the bottom of the sea when the water is shallow. Of course not all gravels and sands contain gold.

Mercury, which readily unites with gold, is put into the gold-bearing gravel, thus catching fine particles of gold which might otherwise escape. The resulting amalgam is separated by retorting—that is the mercury is vaporized by heat and the gold is left free; to be melted into bullion.

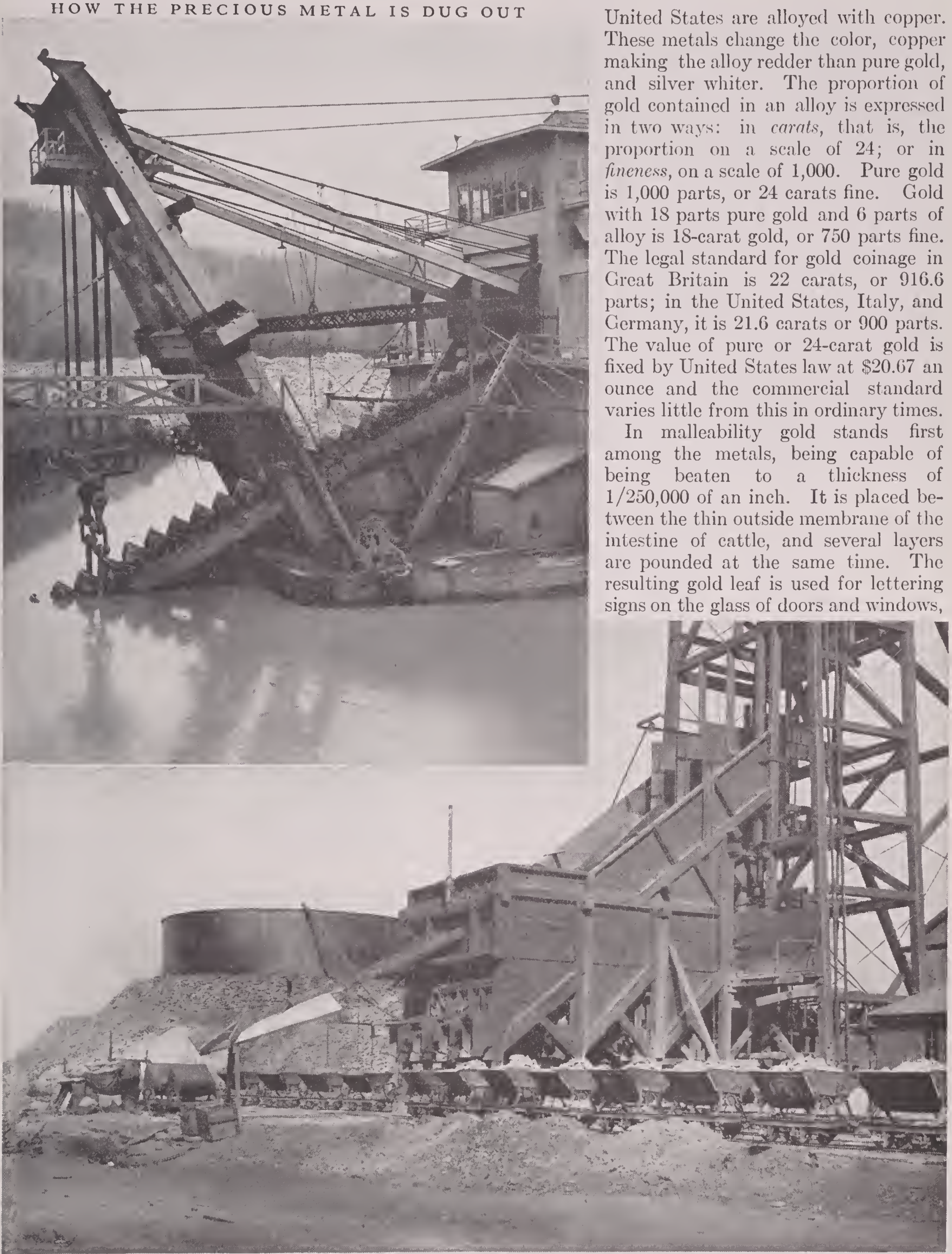
Placer mining is becoming less important because easily obtainable gold is becoming scarcer, and most of the world's gold today is obtained by lode mining. The gold-bearing ores are taken out of the rocks, crushed in stamping-mills, and passed over copper plates covered with mercury to catch as much of the free gold as possible. The ores still contain a large proportion of gold, however, so further treatment is necessary. This usually takes the form of the cyanide process, in which a solution of cyanide of potassium is poured over the concentrated ore, dissolving the gold. From this solution the gold is precipitated on zinc shavings, or by electrolysis (*see* Electrolysis). Another process, less used, consists in roasting the ore to convert all the metals except the gold into oxides, then treating the roasted ore with chlorine gas (*see* Chlorine), which unites with the gold to form gold chloride. The gold chloride is dissolved in water, and the gold is precipitated by various reagents. This chlorination process is less thorough than the cyanide process. In the great Rand mines little more than 55 to 65 per cent of the gold was extracted from the ore before the introduction of the cyanide treatment in 1890. Since then, about 94 per cent of the gold has been saved.

As first extracted from its ores gold nearly always contains some silver, copper, or other metal, which must be separated. This separation, or refining, is done at refineries or at the mint, by electrolysis or by treatment with chemicals. Since pure gold is too soft for ordinary use, it is nearly always alloyed with copper or silver, or both. The gold coins of the

United States are alloyed with copper. These metals change the color, copper making the alloy redder than pure gold, and silver whiter. The proportion of gold contained in an alloy is expressed in two ways: in *carats*, that is, the proportion on a scale of 24; or in *fineness*, on a scale of 1,000. Pure gold is 1,000 parts, or 24 carats fine. Gold with 18 parts pure gold and 6 parts of alloy is 18-carat gold, or 750 parts fine. The legal standard for gold coinage in Great Britain is 22 carats, or 916.6 parts; in the United States, Italy, and Germany, it is 21.6 carats or 900 parts. The value of pure or 24-carat gold is fixed by United States law at $20.67 an ounce and the commercial standard varies little from this in ordinary times.

In malleability gold stands first among the metals, being capable of being beaten to a thickness of 1/250,000 of an inch. It is placed between the thin outside membrane of the intestine of cattle, and several layers are pounded at the same time. The resulting gold leaf is used for lettering signs on the glass of doors and windows,

HOW THE PRECIOUS METAL IS DUG OUT



These machines represent two of the principal methods used in obtaining gold — dredging and mining. In the upper picture is the chain of buckets with which the big dredge scoops gold-bearing gravel from the bed of the California river where it operates. Within the dredge is machinery which extracts the gold. Below is the entrance to a gold mine in the Transvaal, South Africa, showing cars loaded with ore.

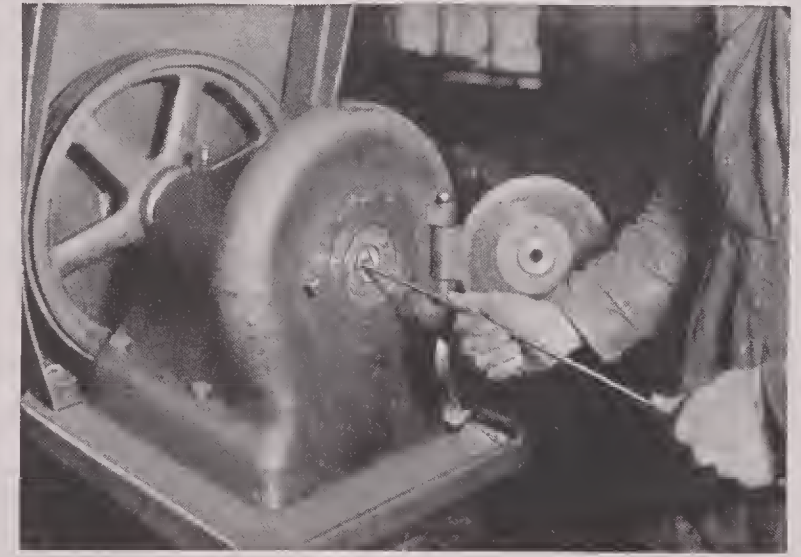
HOW GOLD IS PREPARED FOR USE IN INDUSTRY

These two pictures show how gold is reduced to thin strips for the use of jewelers and others. A bar of gold is passed through the rollers and flattened. A turn of the hand wheel on top reduces the space between the rollers and the bar is passed through again. The process continues until the desired thinness is obtained.

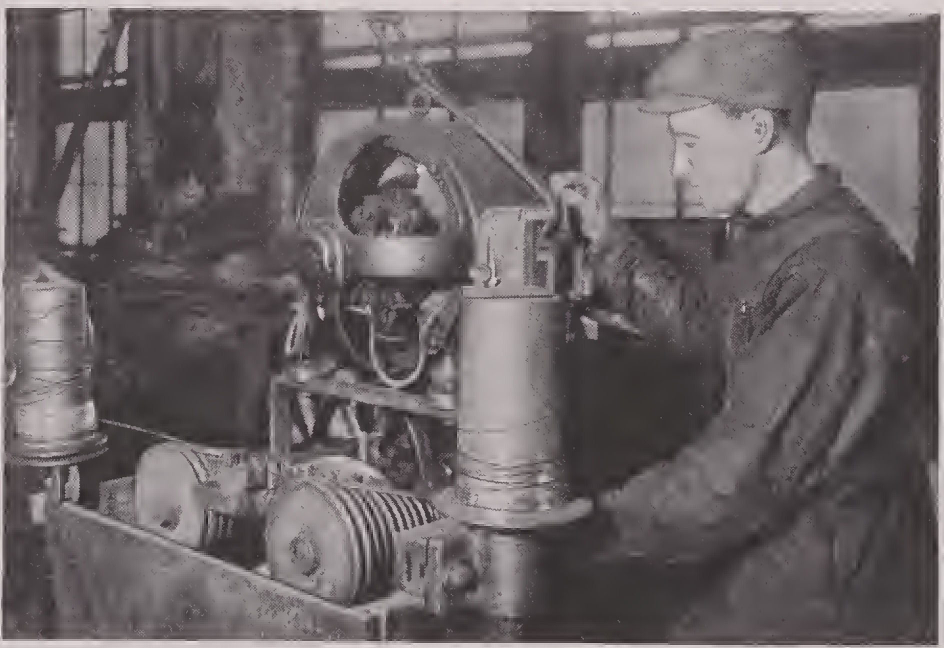
for interior and sometimes exterior decorations, for picture frames, and for experimental work in electricity.

Gold is also the most ductile of metals. Wires compounded of silver and gold have been drawn to such fineness that 20,000 of them would be less than an inch thick, and a length of 500 feet weighs only one grain. Gold lace is made of thin gold wires so fine that from 1,100 to 2,000 yards weigh but an ounce. These wires are flattened into ribbons and wound over silk thread. Cheaper varieties are made of thin copper wire plated with gold.

Rolled gold, which is often used for watch-cases and jewelry, is produced by applying thin sheets of gold to a plate of alloy and rolling them together until the gold and the alloy are firmly welded.



Here we see the making of gold wire. As the wire passes into the machine, many little hammers beat upon it and reduce its diameter.



This machine shows another method of wire making. The wheels draw the wire through a succession of dies, each of which makes it thinner.

Gold resists chemical action to a greater degree than any other common metal. One of the few acids which will dissolve it is a mixture of nitric and hydrochloric acids, which early experimenters called *aqua regia* ("royal water") because of this power. The resulting chloride of gold, in combination with certain other chlorides, forms salts which are called gold chloride and are used in photography. In combination with tin chloride, gold chloride produces a fine purple pigment, called purple of Cassius, which gives a rich pink, rose, or red color to glass, pottery, and enamel. About three-fourths of the world's production of gold is used for commercial purposes. The rest is made into coins, for gold is now the legal monetary standard of most great nations.

GOLDENROD. Tossing and waving in the autumn winds along dusty roadsides and in swampy fields, this spendthrift weed heralds the end of the year's floral pageant like a glorious sunset bringing to the close a beautiful day. Because of its wide distribution in the United States, the goldenrod is favored by many for adoption as the national flower. It offers a veritable Chinese puzzle botanically, for an accurate description and identification of the 85 or more known species would be a hard task for the most learned botanist.

The goldenrod belongs to the family of composite flowers and is akin to the thistle. Only two or three species are found in Europe. One species, the so-called "white goldenrod" or "silver-rod," lacks the characteristic golden hue. Another species, common in the pine barrens of New Jersey, gives off an anise-like fragrance when crushed, and its dried leaves and flowers were formerly used to make a medicinal tea. The goldenrods have a prolonged season of blooming, and the bright flowers and the ease with which the nectar is to be obtained attract many insects. When the flower clusters fade, the seeds tipped with fine feathery hairs are wafted in every direction, later to be sought by the goldfinch and the song sparrow when the winter's store of food runs low.

Scientific name of goldenrod family, *Solidago*. The blue-stemmed or woodland goldenrod (*Solidago caesia*) has an unbranched stem of bluish hue and lance-shaped leaves; the flowers grow along the stalks in the axils of the leaves. *Solidago uliginosa* is the bog goldenrod, with stem 2 to 4 feet high, and with flowers forming a compact terminal spike. The showy goldenrod (*Solidago speciosa*) attains 7 feet in height with widely branching stem often stained with red. The early or plume goldenrod (*Solidago juncea*) is branching but shorter; its plumes are often dried for winter decoration. The Canada goldenrod (*Solidago canadensis*) is probably the largest, showiest, and most common of the family, flourishing from Newfoundland to Florida, and westward to British Columbia and Arizona.

GOLDFISH. Swimming proudly in its suit of burnished gold or bright red jacket with black or silver trimmings, the goldfish knows nothing of its humble ancestor, the dull-colored carp. Yet the wonderful variations of color and form which we find so attractive were produced by the skill and infinite patience of Chinese and Japanese breeders. For centuries individual variations were carefully bred and selected until the golden color was firmly fixed, and innumerable forms, from the beautiful to the grotesque, were produced. But blood will tell; and as soon as the care of the breeder ceases, the goldfish tend to lose their brilliant coloring. Specimens that escaped from the fountains in Washington to the Potomac River have produced young that returned to the original greenish hue.

Some of the most valuable goldfish are not golden at all. For example, the "fantail" is occasionally a brilliant and showy black, and others are virtually white. One of the prettiest varieties is the "fringe-tail," whose enormous shimmering tail produces effects that a dancer might envy as the little fish moves in the sunlight. Probably the ugliest kind is the one most prized in the Orient. This is the "telescope fish," so called because of its large and bulging eyes, which the Japanese are continually trying to make larger and more bulging. In Japan goldfish are so popular as pets that more than 20,000,000 are sold each year.

Scientific name, *Carassius auratus*. It is a native of China, whence it was introduced into Japan and Europe. Goldfish should be fed only once a day, in the morning at a regular time, and only as much as they can eat at once. The best aquarium is one in which water plants are growing. The ordinary fish globe should not be used, since the curving sides allow but a small part of the surface of the water to reach the air (*see* Aquarium).

GOLDSMITH, OLIVER (1728–1774). There are few more eccentric or more lovable characters among literary men than the reckless, irresponsible, happy-go-lucky, generous Goldsmith. He was born in a little village in Ireland, where his father was a simple kindly clergyman, much like Dr. Primrose in the 'Vicar of Wakefield'. Young Oliver was regarded as "a stupid blockhead" at school, and seemed a most unpromising lad in every way. At Trinity College, Dublin, his escapades brought him into disfavor with the authorities, and here he fell into the habit of squandering what little money he had and getting into debt, but he managed somehow to obtain his degree in 1749.

At the urging of his family Goldsmith now spent two years studying theology, but when he presented himself as a candidate for holy orders in the Church of England, he was rejected. He made an attempt at law, but failed in this also. Then he went to Edinburgh to study medicine. After remaining there a year and a half, he set out on a year's tramp through Europe. Earning his way by playing the flute he wandered through Flanders, France, Switzerland, and Italy. He came back with a medical degree, though how he obtained it no one ever knew; and it was of little service to him, for he met with no success in practice as a physician.

Failing in various other occupations, Goldsmith turned to literature as a last resort. In his little garret at the top of "Breakneck Stairs" in London, he wrote essays, reviews, histories, etc., most of which have been forgotten. But among these were a series of observations on English civilization, afterwards published (1762) as 'The Citizen of the World'. These essays attracted the attention of Dr. Samuel Johnson, the great literary leader of the day. He befriended Goldsmith and made him a member of his famous club, to which the actor Garrick, the artist Reynolds, the historian Gibbon, the brilliant orator and statesman Edmund Burke, and other famous men belonged (*see* Johnson, Samuel). In this brilliant circle Goldsmith was laughed at for his oddities and blundering ways, but loved for his goodness of heart and unfailing good humor.

His writings brought him some means, but as a result of his love of gay clothes, and fine dinners, his habit of gambling, and the ill-advised generosity which led him to help any begger who sought his aid, he was always in debt. In his 47th year he fell ill of a fatal fever, which was aggravated by his own attempts to cure himself and his constant worry over his many financial troubles.

"Let not his frailties be remembered," said Dr. Johnson after Goldsmith's death; "he was a very great man." This verdict has been accepted by the literary world. Of all his works 'The Vicar of Wakefield' (1766) is the favorite. Dr. Primrose, the simple, true-hearted clergyman, whose happy faith triumphs over all misfortunes, and the blundering Moses, so like Goldsmith himself, are among the characters that are never forgotten, while the simple, wholesome village life pictured in this novel never loses its power to charm. Much of the same charm is shown in 'The Deserted Village' (1770), one of the few poems in an artificial age to appeal to human sympathy and love of nature. His comedy 'She Stoops to Conquer' (1773) has been played again and again, and its hearty fun never grows stale.

THE CAREFREE OLIVER AND HIS FLUTE

What a lovable, carefree genius Oliver Goldsmith was! Here we see him going across the fields with the beloved flute with which he earned his way in his year's tramp through Europe. Goldsmith needed a little mixture of the practical in his make-up, as this practical and somewhat prosaic age of ours needs a touch of Goldsmith's appreciation of certain great things of life that money cannot buy—the simple joy of living, and the play of imagination.

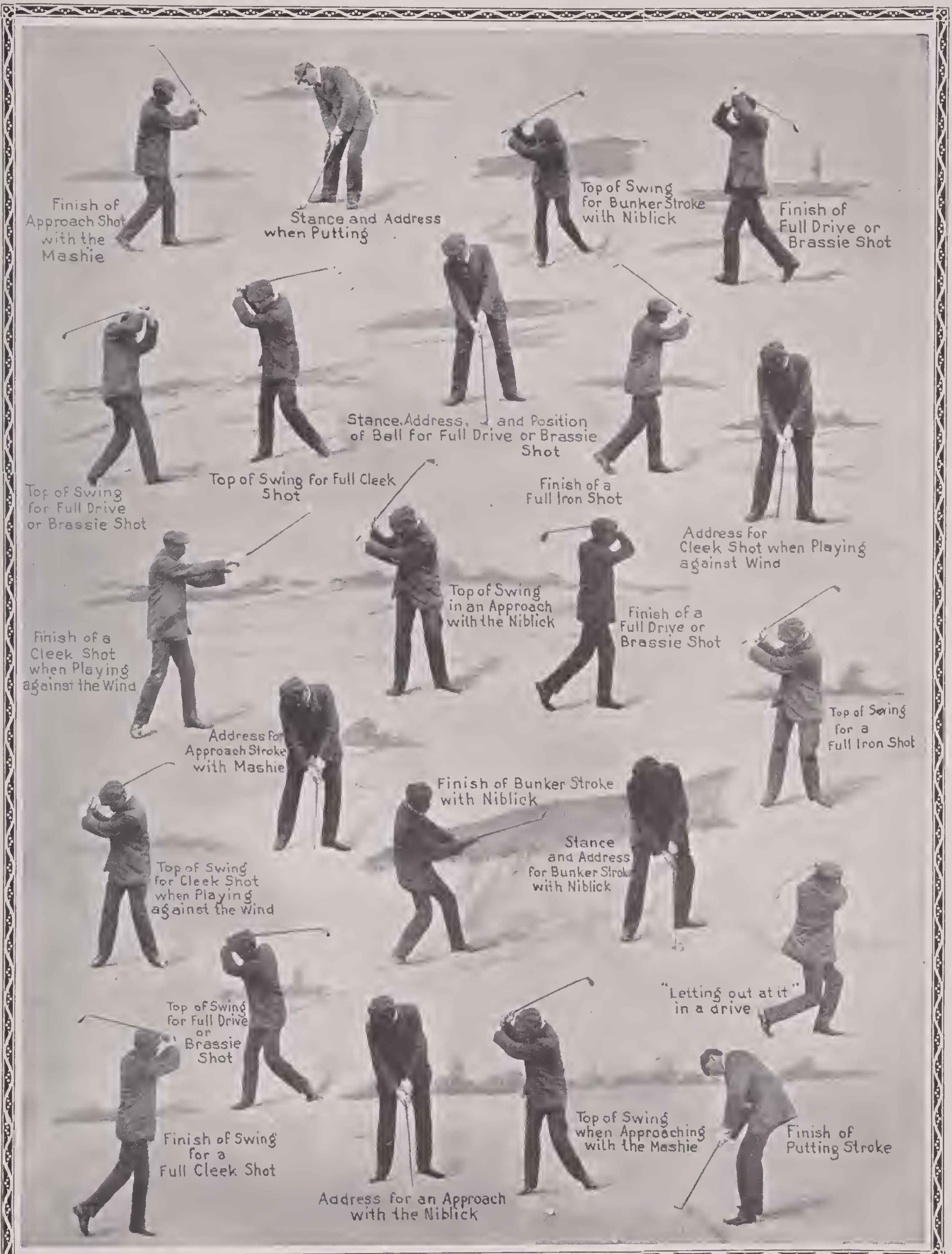
GOLF. Golf is one of the few games for both old and young, for champions in this difficult and fascinating sport have been as young as 18 and as old as 60. More than any other game perhaps, golf calls for a spirit of courtesy and fairness. A player stands quietly aside while his opponent makes his strokes. He assists in every way to give this opponent an equal chance with himself, and should a player lose a ball the other searches for it as diligently as if it were his own. Golf also puts a player on his honor, for he alone keeps track of his own score. These facts, combined with the skill required to excel and the excellent physical exercise obtained, usually in the midst of attractive scenery, fully entitle golf to be known as "the royal game."

The ideal golf course consists of 18 "holes" at various distances apart, from about 100 yards to more than 500 yards. At the beginning of each hole there is a "tee." This is a level plot of ground about 12 feet square, from which the players "drive off" into the "fairway," which is the name given to the broad avenue of turf leading to the hole itself. For 200 yards, perhaps, this fairway is smooth and undulating, with no obstructions, though woods and tall grass may flank it on both sides. Then a "hazard"—an obstruction either natural or artificial, such as a brook or a ditch or a mound of earth fronted by a sand-pit—may cut across the fairway and form a trap for the unwary player. If the golfer hits his ball into one of these traps he may have considerable difficulty in knocking it out, but if he plays skilfully he remains outside the traps and is able to approach "the green," which lies at the end of the hole, without wasting any strokes.

The Green, the Flag, and the Hole

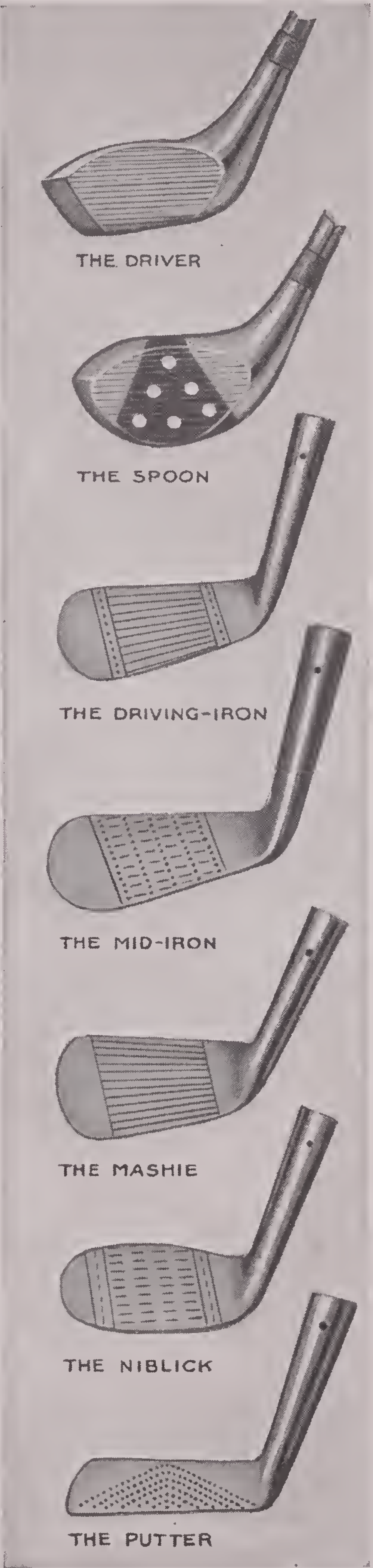
The "green" is a plot of ground of no regulation size or shape, but usually about 30 or 40 feet in diameter. Here the grass is cut close, and in the center is a hole about 4 inches in diameter, lined with metal and designated by a flag or marker on an iron rod or bamboo pole. When the golfer is at a distance from the green, the flag indicates the correct direction for his stroke. As soon as the player succeeds in "sinking" his ball in the hole and his opponent has done the same, they both move on to the next tee and continue to play in the same manner until they have

SOME OF THE STROKES IN "THE ROYAL GAME"


Finish of Approach Shot with the Mashie
Stance and Address when Putting
Top of Swing for Bunker Stroke with Niblick
Finish of Full Drive or Brassie Shot
Stance, Address, and Position of Ball for Full Drive or Brassie Shot
Top of Swing for Full Drive or Brassie Shot
Top of Swing for Full Cleek Shot
Finish of a Full Iron Shot
Address for Cleek Shot when Playing against Wind
Top of Swing in an Approach with the Niblick
Finish of a Full Drive or Brassie Shot
Finish of a Cleek Shot when Playing against the Wind
Top of Swing for a Full Iron Shot
Address for Approach Stroke with Mashie
Finish of Bunker Stroke with Niblick
Stance and Address for Bunker Stroke with Niblick
Top of Swing for Cleek Shot when Playing against the Wind
"Letting out at it" in a drive
Top of Swing for Full Drive or Brassie Shot
Finish of Swing for a Full Cleek Shot
Top of Swing when Approaching with the Mashie
Finish of Putting Stroke
Address for an Approach with the Niblick

These pictures show the correct "stance" (position of the body) and the right way to execute some of the varied strokes that make golf so fascinating a game. Every detail of these shots must be practiced with the utmost care, and any player who hopes to excel must be careful to get them right when starting to learn the game. Bad golfing habits are quickly formed at the outset, and once a player acquires them, he overcomes them only with the greatest difficulty.

THE CHIEF GOLF CLUBS



These are the seven clubs most useful to the golf player.

made the round of the 18 holes. Some golf courses consist of only nine holes, and in that case the usual practice is to make two rounds.

The object of the game is to send the ball into each of the holes successively in the fewest possible number of strokes. In "match" play each hole is counted separately. The winner is the one who has the most holes to his credit when the course has been completed. In "medal" play, the golfer who makes 18 or 36 holes—according to agreement—in the lowest total number of strokes is the winner, whether or not he wins the most holes.

The golfer may play alone or he may play with two or three others. When four play it is common practice to choose partners and to compete in match play. Whenever a player and his opponent complete a hole in the same number of strokes the hole is "halved" and counts for neither.

The ball, about 1¾ inches in diameter, is made of many strands of rubber wound around a core which is usually of solid rubber or steel. The core is sometimes a liquid or paste in a rubber container, with the idea of giving greater resiliency to the ball. The gutta-percha casing is variously marked to lessen wind resistance and give greater carrying power.

Most players use six or eight clubs of different kinds, each adapted for its own particular kind of stroke. The clubs have a slender handle about three feet in length, often made of hickory, and a strong wooden or iron head with which to hit the ball. When driving off at the tees the player may place the ball upon a little elevation of sand that gives him a chance to get the most effective stroke. In driving a ball from a tee the golfer usually uses a wooden-headed club called a driver. Two hundred yards is a good drive, but many players are capable of driving more than 250 yards.

The other clubs—the "brassie," the "cleek," the "midiron," the "mashie," the "niblick"—are variously designed for driving the ball low and far, or raising it high in the air and letting it fall "dead," or clearing obstacles, or "lifting" it out of holes or tall grass. On the green the player uses a short straight-faced club called a "putter." The players' clubs are usually kept in a bag which is carried by a small boy called a "caddie." Many of these boys have developed later in life into champions at the game.

The history of golf runs far back into the early centuries. The Romans, soon after the beginning of the Christian era, played a game with a mallet and a leather-covered ball stuffed with feathers, called *paganica;* the French in early times had a game akin to golf called *jeu de mail;* and the Dutch played a stick-and-ball game on the ice called *het kolven.* In each of these games the object of the player was to send the ball so it would strike a mark such as an upright stick. While the Dutch and the French were still hitting at marks, the Scotch refined the game by making holes in the ground to receive the ball. In 1457 the Scotch were playing the game so enthusiastically that Parliament, either fearing that the game might have a questionable moral effect on the people or that it might supersede archery, forbade the game, and in fact did not cease to interfere with the sport until 1491.

In the United States a crude form of golf was played as early as 1659. The authorities of Fort Orange—now Albany, N. Y.—passed an ordinance in that year forbidding the people to play golf along the streets on account of damage to windows and danger to pedestrians. Not until 1890, however, did modern golf secure its first real foothold in the United States and Canada. Today, it is said, there are nearly a million golf players in North America. The game has had much to do with the increasing number and popularity of country clubs, one or more of which are found near every city of any size in America. Probably the most famous golf course in the world is that of the Royal and Ancient Golf Club of St. Andrews in Scotland.

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GOMPERS, SAMUEL (born 1850). As president for nearly 40 years of the American Federation of Labor, Samuel Gompers is one of the outstanding figures in the American union labor movement. Born in London, at the age of ten he went to work for a shoemaker, but soon became apprenticed to a cigar-maker, and learned that trade. He came to New York with his parents in 1863, and was active in the Cigar-Makers' International Union for many years. Then in 1881 he helped to organize the American Federation of Labor (*see* Labor Organizations), and the next year became its president, a position which he has held ever since except for one year.

During this long period he has maintained a firm leadership of the labor movement, guiding it into moderate channels. Today he is the head of a powerful body of nearly 4,000,000 men and women, of every race, language, trade, and condition. He has constantly opposed the formation of a separate labor party, advocating the use of the indirect influence of the organization in voting for candidates who are friends of labor. Some of the success of this policy may be seen in the laws passed for the benefit of the working man—employers' liability laws, the eight-hour day on government contracts, etc. No capitalist has fought more determinedly against socialism and "bolshevism" than has Samuel Gompers, who declared these movements economically unsound, socially wrong, and industrially impossible. Industrial conciliation, he believes, is the remedy by which the laborer should seek to gain his ends. The vigorous stand he took in support of the participation of the United States in the World War fittingly crowned a remarkable career.

GOOSE. The goose is a bird of wide popularity. Through "Mother Goose" it belongs to the nursery; the fable of the "goose that laid the golden egg" takes it into the schoolroom, where later it figures as the heroic bird that saved the city of Rome, and as furnishing Tiny Tim's Christmas dinner in Dickens' famous 'Christmas Carol'. Sportsmen prize the wild goose, and the domestic goose is of great importance to housewives not only for its flesh and eggs but for its feathers which supply their pillows and feather beds. Goose fat is largely used in place of lard for cooking, and from the livers is made the pâté de foie gras for which Strasbourg is famous.

There are about 30 species of wild geese, belonging to the same family as the ducks and swans. The

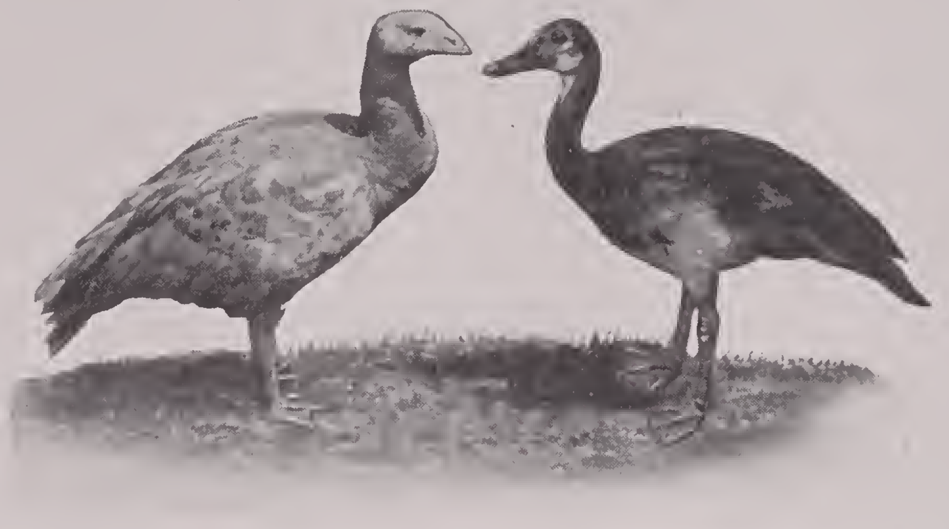
WILD GEESE AT HOME FOR THE SUMMER IN CANADA

The picture shows Mr. and Mrs. Wild Goose escorting their children over a marsh in Saskatchewan, and seeing to it that the youngsters eat and grow strong in preparation for the autumn, when they must make the long flight to the Gulf of Mexico. The picture is from a group in the American Museum of Natural History.

male, called the "gander," resembles the female in plumage. All breed in cool and temperate regions, some in the Arctic Circle. All migrate south for the winter. Geese live to be at least 30 or 40 years old.

Of the European wild geese the "graylag" is the most representative. It ranges over nearly the whole of Europe and northern Asia, and is the original of most domestic geese. China is the home of the "swan-goose," the largest known variety, and the parent stock of the domestic geese of the Orient. The "Cape Barron goose," which is remarkable for the shortness of its beak, is found in Australia.

TWO GEESE OF DISTANT LANDS



To meet the sharp-nosed goose on the left, you would have to go to Australia, for he is a Cape Barron goose with an extremely short beak like a turkey's. He can get around on land much more rapidly than the ordinary goose, but he lacks the family fondness for swimming and flying. Facing him is the African spur-winged goose, who gets his name from a long spur on each wing. He has more of the family nose, as you see.

The "Canada goose" is the most familiar of American wild geese. It is a grain-feeding bird and its flesh is most palatable. Breeding in Canada or the northern United States, it stops in its southward migration to visit the grain and stubble fields of the great northwest, often remaining in the Dakotas until mercury has reached 20° below zero. This is the harvest time for sportsmen, and often family larders are provided with meat from this source for the entire season. The birds are about 40 inches in length, light gray plumage below and darker grayish brown above, with a black head. In their spring flight north they are welcomed as an unfailing sign of coming summer. They fly high, in a V-shaped wedge, their joyous honking claiming attention of young and old:

> Hark what a clamor goes winging through the sky!
> Look, children! Listen to the sound so wild and high!
> Like a peal of broken bells,—kling, klang, kling—
> Far and high the wild geese cry, "Spring! It is spring!"
> —*Celia Thaxter.*

The "snow goose" is a pure white arctic bird that migrates to the Gulf States in America and to Japan on the Asiatic coast. They are still numerous along the Pacific coast during the winter. The "brant" is a small goose common throughout the Northern Hemisphere. In early autumn these birds come by the thousands to the coasts of the United States, and are a plentiful and valuable source of food supply for our tables.

Domestic geese date from a very remote period, as they are shown on the monuments of ancient Egypt. Wing-feathers of the goose feathered man's arrows in the Middle Ages, and supplied him with quill pens until steel pens took their place.

Geese belong to the order *Anser*. Scientific name of graylag goose, *Anser anser;* of Canada goose, *Branta canadensis;* of the brant, *Branta bernicla glaucogastra.*

GOOSEBERRY. The tart flavor of the gooseberry is enjoyed in sauce, jam, and marmalade, but does not greatly tempt one to pick and eat the raw fruit. Even as the fruit ripens, changing from green to a rich dark purple, the acid flavor lingers, especially around the coarse seeds. So the gooseberry is not very popular among garden fruits, and much of our supply comes from the bushes growing wild all through the northern part of the United States. Varieties of the gooseberry are also native to the north temperate regions of the Old World, but everywhere the cultivation of the fruit has been neglected with the exception of England. There cultivation began in the 16th century, with the result that English markets have gooseberries as large as plums and sweet enough to eat just as they are picked from the bush.

The gooseberry is a hardy spiny shrub closely related to the currant. Scientific name, *Ribes grossularia.*

GOPHER. In the early days French settlers gave the name "gopher" to several species of burrowing animals of the rodent family. The name comes from the French *gaufre* ("honeycomb"), and was given because the little animals honeycomb the ground by burrowing in it. They do much damage to the crops and are considered a great pest by the farmers.

The prairie pocket gopher commits its depredations in the fertile prairie region of the farther northwest. It is about as long as a small rat, with a body considerably thicker; in the skin of each cheek is a large pocket or pouch in which to carry stores of food. The fore feet are very strong and are equipped with long claws for digging.

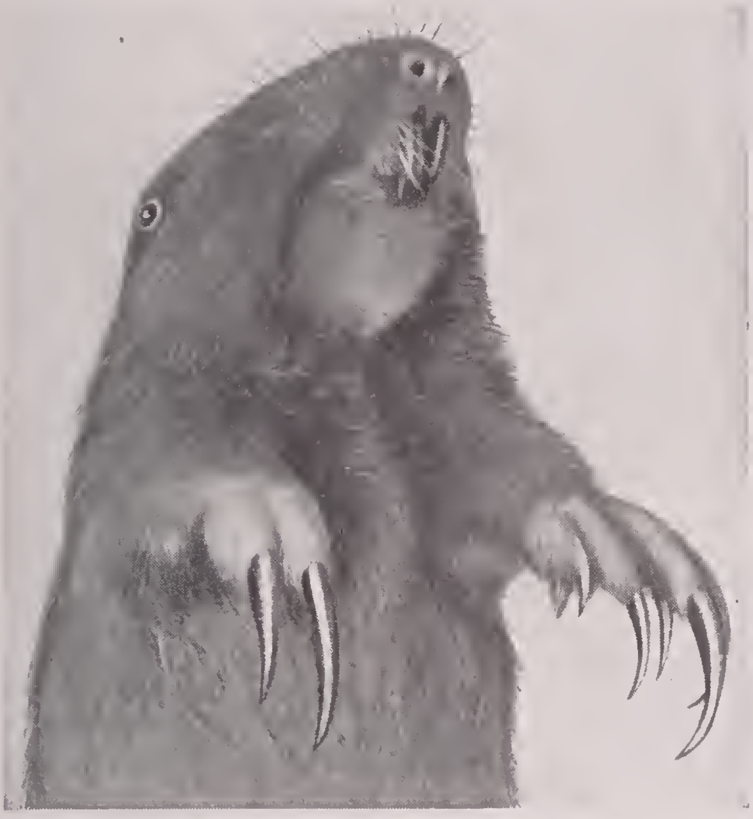
With his hind feet the gopher scrapes from beneath his body the dirt the front feet have dug and throws it back a distance of 8 or 10 inches. When a little pile has been made in this way, the gopher turns around and putting his forepaws in front of his nose pushes the dirt before him through one of his "cellar doors" and so makes the little piles called gopher hills.

The gopher's teeth make something like 200 strokes a minute. The enamel plates of the molar teeth are arranged in such a way that 38 distinct single cuts are made with every forward thrust of the jaw and

28 by the back stroke. Multiply that by 200 and it amounts to over 13,000 cuts every minute.

To keep food for winter use, gophers have regular storehouses — pantries, as it were — to which they carry roots and other food in their cheek pockets. In one gopher storehouse in the winter time were found nearly 50 tiger lily bulbs, gathered the previous fall and carried through a tunnel from the tiger lily bed to the gopher pantry. Gopher burrows are extended year after year, and in many cases the tunnels dug by a single gopher in 12 months would measure a mile or more if straightened out and placed end to end. The tunnels are full of crooks and turns, caused by going around stones or following "leads" of soft earth.

MR. GOPHER AS A BUSINESS MAN



A Gopher is a clumsy looking fellow, but how he can cut and stow away the roots! With those long upper front teeth he anchors himself to his job; then the lower incisor shoots back and forth like a steam drill until he has cut off a piece of root and passed it into his mouth. The digging and shoveling are done with that short stout nose and those long powerful curved claws that seem almost too big for him.

The so-called "striped gopher" of the Central States is really a ground squirrel but it is no less troublesome. Natural enemies of these pests are the weasel and the gopher-snake. Farmers also try to keep their numbers down by traps and poison.

Pocket gophers are a large family, the United States having three genera with 78 species and subspecies, which vary widely in size and color. Scientific name of the prairie pocket gopher, *Geomys bursarius*.

GORDON, GEN. CHARLES GEORGE (1833–1885). "Chinese Gordon," as he was commonly called, was a British officer whose love of danger, combined with a religious enthusiasm which verged on Oriental fatalism, crowded his career with romantic adventures. One of the secrets of the extraordinary deeds he accomplished was his genius for leadership, especially among non-European peoples.

He was the son of a British general, was educated at the Royal Military Academy at Woolwich, and began his career in the British army in 1852 with a lieutenant's commission. He served with conspicuous gallantry in the Crimean War, and afterwards in Asia. At the age of 30 we find him commander of the "Ever Victorious Army" of China, putting down the Taiping rebels who sought to drive out the unprogressive Manchus and to establish "the reign of eternal peace." In 1864, within 18 months after Gordon had taken command, the ten-year-old rebellion which had cost millions of lives was relentlessly suppressed. The grateful Chinese thereupon conferred on Gordon the yellow jacket and the peacock feather of a mandarin.

The next nine years of his life were spent in the more prosaic but perhaps more useful work of constructing forts in England and serving on various international commissions. Then in 1873 he accepted service under the Khedive of Egypt as governor of the Egyptian equatorial province. For seven years he labored to establish law and order, but his work was not very successful.

In 1884, four years after he resigned this commission, he was sent back to the Sudan by the British government. His commission was to bring out of the region the Egyptian garrisons endangered by the revolt of the "Mahdi" or Prophet, a religious leader whose aim was not unlike that of the Taiping rebels in China. But in disregard of his orders General Gordon sought to hold the district and was besieged in the city of Khartum. For ten months the city held out; when it finally fell (Jan. 26, 1885), two days before a British relief expedition reached it, the whole garrison, including its brave but erratic commander, was massacred.

The death of Gordon raised a storm of indignation in England against the slowness of the government in sending aid. Gladstone, then prime minister, pointed out that Gordon had disobeyed his orders in not leaving the Sudan when he could, but public opinion could not forget his chivalrous heroism and regarded him as a martyr. So he was —to his own headstrongness and the spirit of imperialism, which, however, did not rule the councils of the Liberal government then at the helm in England. Tennyson wrote the epitaph for his tomb in Westminister Abbey.

CHARLES GEORGE GORDON
One of England's Warrior Heroes

ONE OF AMERICA'S GREATEST CONQUERORS

The Man who Vanquished the Deadly Mosquito

WILLIAM CRAWFORD GORGAS

GORGAS, GEN. WILLIAM CRAWFORD (1854–1920). It is a great thing to uphold the honor of one's country on the battlefield, especially when the conflict is in defense of liberty, of justice, of the rights of men peaceably to rule their affairs. But there are conquests even greater than those over hostile armies—such are the conquests over the forces of disease and death and the suffering of little children. And so we may truly say that one of the greatest conquerors that America ever produced, a man worthy to rank with Washington or Grant or Pershing, was an army officer who only late in life rose above the rank of colonel; who conquered malaria and the deadly yellow fever in Cuba and the Panama Canal Zone and thus made possible the construction of the Panama Canal; and who at his death, at the age of 66, was recognized as the world's foremost sanitarian.

The family of William Crawford Gorgas was well known in Alabama, where the boy was born shortly before the Civil War. His father was a general in the Confederate army and the collapse of the Southern cause brought the family a full share of hardships. "I first came to Baltimore," said the son, at one time, "about 45 years ago—a ragged, barefoot little rebel, with empty pockets and still more empty stomach. My father had gone south with Lee's army. At the fall and destruction of Richmond, my mother's house, with all that she had, was burned, leaving her stranded with six small children. She came to Baltimore, and was there cared for by friends. These memories are vivid with me, and can never be effaced."

Young Gorgas received his education at the University of the South at Sewanee, Tenn., of which his father had become president. After graduating from Bellevue Medical College, New York, he entered the United States Army as a surgeon, and while stationed at Fort Brown, Tex., had his interest first aroused in the terrible scourge—yellow fever—which he was later to do so much to combat and conquer.

Dr. Gorgas in the Spanish-American War

During the Spanish-American War Dr. Gorgas served as chief sanitary officer of Havana, Cuba, which for years had been notorious as a center of yellow fever. There he won his first world fame by ridding the city almost entirely of this plague. He was practically the first to apply the new discoveries—that both malaria and yellow fever can only be spread by the bites of certain species of mosquitoes, which in turn have become infected by biting persons infected with these diseases (*see* Mosquito).

In reward for his work at Havana Dr. Gorgas was created colonel by special act of Congress, and shortly afterward was appointed as chief sanitary officer of the proposed Panama Canal.

The story of the great work which he did there is told more fully elsewhere (*see* Panama Canal). Colonel Gorgas and his men worked especially in four great ways: They destroyed the homes of mosquitoes during the larval stage within a hundred yards of all human dwellings; they destroyed all protection for adult mosquitoes; they screened all houses with wire screens; and they destroyed all breeding-places, either by draining stagnant waters dry or sealing them with crude petroleum, which spreads a film over the surface and kills the larvae.

The War against the Death-bearing Mosquito

Never was there known so great a "pouring of oil upon troubled waters"; never was there known so silent a battle between an army of hundreds on one side and hundreds of millions on the other. On one side were a few hundred men—doctors and ditchers, drainers and dispensers, oilers and clerks and sanitary inspectors—guarding 40,000 or 50,000 laborers and their families, scattered over 450 square miles in about 40 camps and villages. They were doing the biggest piece of engineering that has ever been done on the earth, digging a way from sea to sea, cutting up a mountain for the sea to pass through, and building huge walls to hold in the sea as it passed. On the other side were millions of mosquitoes of the race *Stegomyia* and *Anopheles*, born in stagnant waters, but emerging with their powers of death to fly through every door and window to suck the blood of any human being and poison the life-blood of all Panama, as their ancestors had poisoned it for ages, with yellow fever and malaria.

Without the remarkable work of Colonel Gorgas in stamping out these diseases, the canal might never have been completed, certainly not without appalling loss of life. It has been estimated that in the ten years that the canal was building he saved more than 70,000 lives, and $80,000,000. His achievement marked an epoch in the history of sanitation, and in the work of making the tropics habitable for the white man. It was not too much now to expect, as Colonel Gorgas prophesied, that "some day a case of yellow fever will be regarded as a medical curiosity."

At the completion of the canal, in 1914, Colonel Gorgas was promoted by his government to be Surgeon-General of the United States Army, and next year was given the rank of major-general.

In the Service of Great Britain

He had already, at the request of the British government, visited South Africa, to help check the plague of pneumonia from which thousands of negroes in the mines were dying. After his retirement from the army, in 1918, he was asked again to visit Africa to investigate sanitary conditions in West Africa; but he died in London before this work was finished. General Gorgas had received high honors of all sorts during his life, and after his death the British government took official charge of his funeral in St. Paul's Cathedral, London.

GORILLA. The largest and most manlike of all the apes is the gorilla, a native of the dense forests of central Africa. Gorillas stand and walk erect more frequently than the other apes, which led early explorers to mistake them for savage men. Their bodies are covered with a mixture of gray and brown hair, they have flat noses and very prominent ridges over the eyes, and their facial expression is hideous and brutal. They are very ferocious, but they feed upon berries, sugar cane, and other vegetables. They live in pairs, with their offspring, rather than in troops. Very few civilized persons have seen a live gorilla as they are scarce and difficult to capture and do not live long when taken from their native forests. An old male gorilla which was killed in 1919 stood 5 feet 11 inches in height; measured 58 inches around the chest, 67 inches around the stomach, and 7 feet from tip to tip of his extended arms. Its weight was not stated, but gorillas weighing more than 400 pounds are on record. (*See* Ape.)

A BABY GORILLA

Not an unpleasant face — do you think — for a Gorilla? But he's only a baby. Later he will develop tusklike teeth and a ferocious scowl.

GOTHS. First of the northern barbarians whose successive assaults brought low the might of Rome were the Visigoths or West Goths. Where the Goths first came from is not definitely known. There were stories told by their old men of a time when their people had dwelt far to the north, on the shores and islands of what is now Sweden. Then had come long slow wanderings, through the forests of western Russia, until they reached the shores of the Black Sea. In a hundred years of contact with the Romans, they learned many things, especially the Christian religion.

This was spread among them by the efforts of a convert of their own race, a saintly man named Ulfilas. For more than 40 years he labored, first making a Gothic alphabet into which to translate the Bible, and then teaching his people the new faith. This Bible translated by Ulfilas is centuries older than the earliest writing which we have in any other Teutonic language, so its historial value is very great.

For a time the Goths ruled a great kingdom north of the Danube River and the Black Sea. Then the Huns swept into Europe from Asia, in 375 A.D., conquering the Ostrogoths or East Goths, and forcing the Visigoths to seek refuge across the Danube within the boundaries of the Roman Empire. In a battle fought near the city of Adrianople, in 378, the Visigoths defeated and slew the Emperor Valens. For a time they lived peaceably on Roman territory; then, on the death of the Emperor Theodosius in 395, they rose in rebellion under their ambitious young king Alaric, and overran a large part of the Eastern Empire. Rome itself fell into the hands of the impetuous Goths in 410 (*see* Alaric).

Alaric's successors led their people out of Italy and set up a powerful kingdom in southern Gaul and Spain. In the year 507, the Visigoths in Gaul were defeated by the Franks and were forced beyond the Pyrenees. For 200 years their kingdom in Spain flourished. It did not come to an end until 711, when the Moors crossed over from Africa, and in a terrible eight-day battle destroyed the Visigothic kingdom. (*See* Spain.)

The Ostrogoths for a time formed part of the vast horde which followed the king of the Huns, Attila, settling in the lands south of Vienna when the Hunnish kingdom fell apart. Their national hero was Theodoric the Great, a powerful and romantic figure who became king in 474. When a boy he had been sent as a hostage to Constantinople and had there been educated. In 488 he invaded Italy, with the permission of the emperor at Constantinople. After several years of warfare Theodoric captured and slew Odoacer, a barbarian who had there usurped the Roman power and founded a powerful kingdom, which included all Italy together with lands north and east of the Adriatic Sea. His reign was one of the ablest and best in this period, and his kingdom was one of the great "might-have-beens" of history. He failed largely because no permanent fusion was effected between the barbarians and the Christian-Roman population. All his wise plans for bringing this about proved futile because the Ostrogoths, in common with most of the German barbarians, had been converted to Arianism, an heretical form of Christianity, and so were hated by the orthodox.

After Theodoric's death, in 526, the generals of the Eastern Empire reconquered Italy (*see* Justinian I, Emperor of Eastern Roman Empire). After their last battle (near Mount Vesuvius, in 552) the Ostrogothic nation marched out of Italy, to mingle and merge in other barbarian hordes north of the Alps, and disappeared from history.

GOURDS. Over the back porch or the milk house of an old-fashioned farmhouse a gourd vine is almost sure to be found trailing its downy leaves and pretty white blossoms. In pioneer days this vine was more than a luxuriant climber, for from the hard-skinned thin-fleshed shell of its fruit were made such everyday necessities as dippers, spoons, water-bottles, and other primitive utensils.

The "gourds" or fruits of the various species assume many strange shapes and range from a few inches to five feet in length. One variety grown in America is called the "vegetable sponge" or dishcloth "gourd," because the fibrous character of its interior when dried adapts it for these uses. From the neck of the calabash gourd of South Africa are made pipes highly prized by smokers.

Gourds belong to the family *Cucurbitaceae*, and are distinguished from the closely related pumpkins, squashes, and melons by having white instead of yellow flowers. In Europe the members of these edible species are also popularly known as gourds. The American bottle gourd is *Lagenaria vulgaris*.

GRAIN ELEVATORS. Dotted along the railways in the grain-growing regions of the United States and Canada are thousands of structures, called "elevators," for storing grain and loading it into freight cars. At various central and terminal points are hundreds of larger elevators, to which the grain is brought from the country elevators to be stored until it is needed for milling or export. Nearly all modern elevators are of reinforced concrete, and consist of several huge cylindrical bins like silos. A great cupola at the top contains the machinery and spouts for handling the grain. In the largest plants the machinery is housed in a separate "working house."

The largest elevator in the United States, the Armour Grain Company's elevator at Chicago, has 130 storage bins, 104 feet high and 22 feet in diameter, with a capacity of 4,383,000 bushels. The working house contains in addition 93 bins, 74 feet high and 14 feet in diameter with a capacity of 931,000 bushels, for receiving, shipping, cleaning, drying, and bleaching. At Port Arthur, Canada, the Canadian Northern Railway Company has an elevator with a capacity of 9,000,000 bushels.

Grain is unloaded from the cars and hoisted into the elevators by buckets attached to an endless belt, or is sucked up in huge pneumatic tubes. Sometimes a great steam shovel scoops the grain into hoppers below the tracks, from which it is hoisted in the belt conveyors. In the cupola the grain is discharged through spouts into garners, then into hoppers where it is weighed, and then into the storage bins. If necessary it goes into the cleaning and bleaching bins before it is put into storage.

On the Great Lakes, vessels are loaded by a number of huge spouts, through which the grain pours into the hold at such a rate that the largest vessels are loaded in two or three hours.

Dissatisfaction with marketing conditions under the old system of railroad-owned country elevators has recently led in the West to the building of many coöperatively owned elevators, which now handle a considerable proportion of all grain marketed in the United States. (*See* Wheat.)

TOOLS *of Our* EVERYDAY SPEECH

Rules that Help You to Say in the Best Way what You Mean — Correct English, the Most Widely Accepted "Trade-Mark" of an Educated Person

GRAMMAR. Some people say that the hammer is the commonest tool in the world. Others hold that knives and forks are used more frequently, and others that dishes are still more common. In fact, it is a very interesting game to decide which is the most common of all, especially if by tool we mean anything that people use. But the most common tool of all is one that you would never think of in a year. It is called a "sentence." So interesting is this tool that we shall take a little time to show what it is like, and how to use it. To use it properly is very important, much more important than using a hammer, for instance. If you do not use hammers properly you may hit your thumb or bend the nail or mar the wood, but if you do not use sentences properly, — that is, if you speak or write ungrammatically — people may mistake your meaning in listening to you, or may think that you have not been well taught, or may even think you are a very careless person.

If you take any book, one like this which you are reading, you can easily learn to pick out sentences. We have already written ten of them, including this one sentence. Some of the marks by which you can recognize a sentence are as follows:

First of all, it is necessary to know that a sentence is a group of words expressing a complete thought. For instance, *A dog* is not a sentence, but *A dog bites* is. *Old King Cole* is not a sentence, but *Old King Cole was a merry old soul* is a complete sentence.

Second, a printed or written sentence always begins with a capital letter. This is very important to remember, because many children forget to begin their sentences with capitals, and so do not use this very common tool properly.

Third, at the end of every sentence there is always a period which looks like this (.), or an interrogation mark (?), or an exclamation point (!). It is always a safe rule to put a period at the end of the sentence except when you ask a question, as *Where is my hat?* or when you are very much excited and cry, *The house is on fire!*

The Need for Proper Punctuation

With these last two rules one can go through a book and count the sentences very easily. Suppose you read again the first ten sentences of this article and see if we have counted correctly. But you cannot be sure about these rules in some compositions written by boys and girls, even in the high school. For instance:

"I got my first pair of skates on my seventh birthday they were more fun than anything else I ever had. It began to thaw the day before my birthday. so that I had to wait nearly a week for the river to freeze again before I could try them."

The boy who wrote this wasn't careful to show you where one sentence ended and the next began. The first complete statement ends with the word *birthday*, so he should have put a period after that word and started *they* with a capital letter. He was right in putting a period after *had* and starting the next word with a capital, because the second complete statement ended with *had:* but the next complete statement runs all the way to the end of the paragraph, and so the writer was wrong in putting a period after *birthday.*

Sometimes sentences have what seem like two or more sentences in each, but they are not *exactly* sentences, and so they are called *clauses.* For instance I may say: *I am sick. I ate ice cream.* But it would perhaps be more nearly true to say: *I am sick because I ate ice cream.* Here the two clauses are joined by the word *because.*

The Words that Tie Sentences Together

These words that join sentences are called "conjunctions." It is interesting that they also join words and what are known as phrases. In the sentence, *Jack and Jill went up the hill*, the word *and* is a conjunction joining two other words. And in the sentence, *It is in the kitchen or under the table*, the conjunction *or* joins the two phrases, *in the kitchen* and *under the table.*

The most common conjunction is *and.* This word some people use too frequently, hitching all their ideas together. For instance:

"I awakened early and dressed and found the bait and went fishing and caught eight pickerel and I came home and gave them to mother and she asked me to clean them and she fried them for us and they certainly tasted fine."

This looks like one sentence; but it is not really one, for it would sound much better to break up this long statement and say:

"I awakened and after I had dressed I found the bait and went fishing. I caught eight pickerel. After a while I came home and gave them to mother, who asked me to clean them. Then she fried them for us. They certainly tasted fine."

If you have ever been in a museum you may have seen some of the earliest forms of the common tools which we use today. For instance, the oldest plow is a pointed stick with which the ground was dug up by sticking the point in and prying up the soil. Many improvements were made until we now have great gang plows hitched to tractors run by gasoline.

The same is true of the sentence. Long years ago the sentences we now use were single words. In fact, the first sentences of little children are still single words. A baby gets hungry and cries "Milk," or touches something and says "Hot." What you would say might be, "I want some milk," or "This oatmeal is hot." This is because you use the most improved form of sentences. However, just as it took a long time for people to learn to make our improved plows, so it took many thousands of years for people to work out the improved form of the sentence we now have.

Sentences Only One Word Long

And oddly enough, we all still use a form of sentence which consists of one word. For instance, we say *Ouch! Fire!* or *Oh!* These are called "interjections" because they are words that express strong feeling. It is quite clear that such words are not very definite, because *Ouch!* may mean *I stubbed my toe* or *I hit my finger* or *Tom pinched me.*

But they are very handy tools to use when we are in a hurry and are quite excited about something. If I call *Fire!* people will come, even though they do not know exactly what is on fire or where it is.

Although people first used a single word for a sentence, and little children still do so, as soon as they wanted to be more definite they split the sentence into parts. Instead of saying "hurt!" the little child says "Finger hurts." He has then discovered the two parts to our sentence—"subject" and "predicate." The subject is the thing we talk about—*finger*, in this case, and the predicate indicates what is said about it—*hurts*, the baby says.

Now, all sentences can be divided into these two parts. No matter how long or complicated a sentence may be, this is true. In the sentence "The largest city of South America is Buenos Aires," the subject is not one word, but many. It is, *The largest city of South America.* The predicate is, *is Buenos Aires.*

Nouns that are Common and Nouns that are Not

In the sentence "Finger hurts," *finger* is the name of something, just as city, South America, and Buenos Aires are names of places. These name words are called "nouns." They may name some particular person or place, like *Charlie Chaplin, John, United States, Chicago;* or they may merely name a group or class of things, like *pen, dog, city.* You notice that most nouns begin with small letters but the names of persons and places begin with capital letters. The first of these classes we call "common nouns," and the second "proper nouns."

The Business of the Verbs

If we went about merely saying nouns to one another, we should not be able to make our meaning very clear. If a boy shouted "Baby" to his mother, she would probably think that the baby had fallen into a bucket of hot water, or out of bed. If the boy said "Baby" quietly, his mother would wait for the next word. She would want to know what the baby was doing or in what state or condition he was. If the boy said "Baby walks," the question in her mind would be answered by an "action" word *walks*. If he said "Baby is hungry," the question would be answered by an "existence" word *is*. Such a word doesn't show action; it merely links *baby* and *hungry*. The words which show action and those that link the subject to something said about it are "verbs." *Run, jump, play, eat, sleep, read, write* are all "action verbs." *Is, are, were, have been, will be,* are all "linking verbs."

The Little Substitutes for Nouns

A ten-year-old boy named James in talking to his mother would not say "James is hungry. James wants an apple." He would have noticed that people do not speak of themselves by name but use the words *I*, *me*, and the like. He would say "*I* am hungry. *I* want an apple." If he were a generous little boy he might say "John is hungry; *he* wants one too." The word *he* would stand for John. These substitute words are called "pronouns" because they are used *for* nouns; and the Latin word meaning "for" is *pro*. *I, he, you, they, them, me, we* are all pronouns.

Adjectives and the Art of Speech

So far we have talked about five of the eight kinds of words, or "parts of speech"—nouns, pronouns, verbs, conjunctions, and interjections. One can build many sentences with only these five kinds of words, but if there were no other parts of speech we should not be able to say many things that we should like to. For example, suppose you had lost a coat and were trying to tell about it so that people would know which coat you meant. If you said "Did you find a coat?" nobody could help you very much, in a large school especially, because perhaps other boys also had lost coats. But if you said, "I lost a *blue* coat," there would be more chance of your finding it. *Blue* adds to the meaning of coat—it describes it. You might have used *large*, or *old*, or *shabby*, or *new*, in place of, or with, *blue*. All these words that add to the meaning of nouns are called "adjectives."

How Adverbs Help the Verbs to Talk

If only one blue coat had turned up at the lost-and-found desk, you might not have much trouble in claiming your own. But suppose that four coats, and four blue coats, were awaiting their owners. You might have to tell other details to the man in charge, the *time* you lost the coat, the *place* in which you left it, or *why* you were so long about claiming it. You might say "I lost a blue coat yesterday in the basement." Then *yesterday* and *in the basement* would tell time and place. They would make the verb *lost* more clear, and would add to its meaning. The coat found in that particular place (*in the basement*) and at the time (*yesterday*) would be identified as yours.

Such words or groups of words that narrow down or add to the meaning of verbs are called "adverbs" or "adverbial phrases." The word adverb is easy to remember because *ad* means "to" or "near." In the sentence "Very heavy clouds rolled quickly across the sky," you will discover a new way of using a helping word, if you look closely. We have had adverbs modifying or changing the meaning of verbs, but now we have a word modifying an adjective. The writer was not satisfied with saying that the clouds were heavy. He added the word *very* to make *heavy* more intense. *Very* is an adverb modifying an adjective. If the writer had wanted to make *quickly* more intense he might have said *very quickly* instead of *very heavy*. In that case the modifying adverb would have helped out the meaning of another adverb. Adverbs, then, may modify verbs, adjectives, or other adverbs. Just as adjectives themselves, they may be single words or groups of words.

How the Prepositions Help Out

In some of the little groups of words used so far, as *in the basement*, there are expressions which have not as yet been explained. In the sentence "I lost my coat in the basement," *in* is a new kind of word. It is a "relation" word; it shows a connection between *lost* and *basement*, but it doesn't mean anything alone. Such words are "prepositions." They show the relation between nouns or pronouns and some other word in the sentence. Thus in "The boy on the fence has a new bat," *on* is a preposition which shows the relation between *boy* and *fence*. These prepositions always have nouns or pronouns for objects.

Only Eight and You Know Them All!

Now you have learned the names of the eight parts of speech and something about each of them. You will be interested to know that all the hundreds of thousands of words in the dictionary belong to one or another of these eight classes. Everything that has ever been thought or written or spoken in the English language has been expressed by grouping together these parts of speech. Uneducated persons often have great difficulty in making others understand just what they want to say, because they do not know enough about words and sentences and how to use them. That is why it is important for you to learn "grammar," which is the study that tells you how to use these valuable tools.

You will find many other interesting and important facts about the parts of speech, and how to use them correctly, if you will turn to the articles in this work under the headings Adjective; Adverb; Conjunction; Noun; Preposition; Pronoun; Sentence; Verb.

How Grammar Helps You to Think

Grammar, as the science of language, has always had an important place in the schools. Three hundred years ago and for a long time after, grammar, especially Latin grammar, held the first place. But with the growth of the common school system grammar dropped into the background. Even in the grades of the common school grammar holds a less important place than formerly. More thoughtful teachers omit formal grammar almost entirely in the first six grades, leaving it to the last year or two of the grammar school.

The general tendency of modern education is to make all studies more concrete and realistic; and, in agreement with this notion, geography, nature study, literature, history, and manual training have gained a more important place in schools, while grammar has lost.

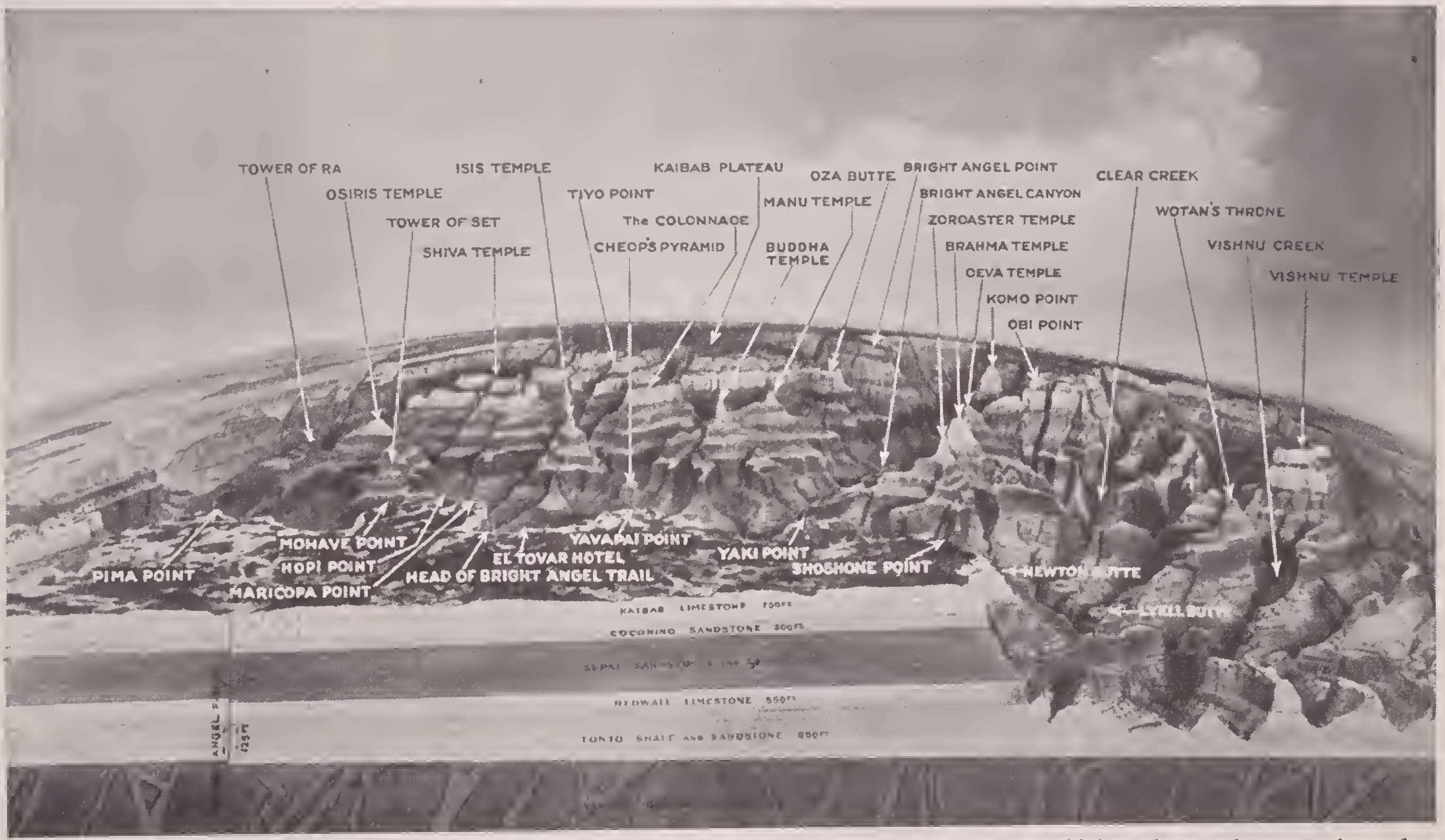
The real value of grammar may be stated thus: All human thought is expressed chiefly through language and, at bottom, the rules of correct thinking are involved in the study of grammar. Correct language is the popular form of logical thinking. To analyze sentences, to examine the structure and arrangement of the parts, to study the various modes of expressing thought and shades of thought grammatically—these activities have always been regarded as the most fundamental and universal method of disciplining the intellectual faculties. In this respect grammar contributes an element of logical accuracy to all studies and lays a basis for correct thinking. The study of grammar also teaches correct usage. Students of more mature years are greatly helped in correcting their faults by insight into the rules of grammar. They learn to criticise themselves and the wrong usages to which they have been accustomed.

The method of teaching grammar has been a subject of much controversy among educators. The older grammars were essentially deductive, proceeding from rules and principles to examples and further applications. Some of the later grammars have emphasized the inductive approach to the rules of grammar. In the inductive method the analysis of sentences is put first. Out of this study of sentences develop later the rules of syntax and the classifications of forms of speech and usages. Some of the more recent grammars have taught the subject in the way indicated above—as a *thought* study, an analysis of the processes of thinking rather than a formal treatment of words and sentences.

Students in the high school, employed in the study of German or French (or it may be Latin or Greek), are believed to receive a grammatical training superior to that given by the study of English. A chief argument for the study of Latin is, first, its linguistic disciplinary training, and second, its reflex influence upon English grammar and speech. Latin has had a great historical influence in determining the development of English speech. It has supplied many words and phrases and has shaped English speech through great writers who were fully saturated with Latin language and Latin style.

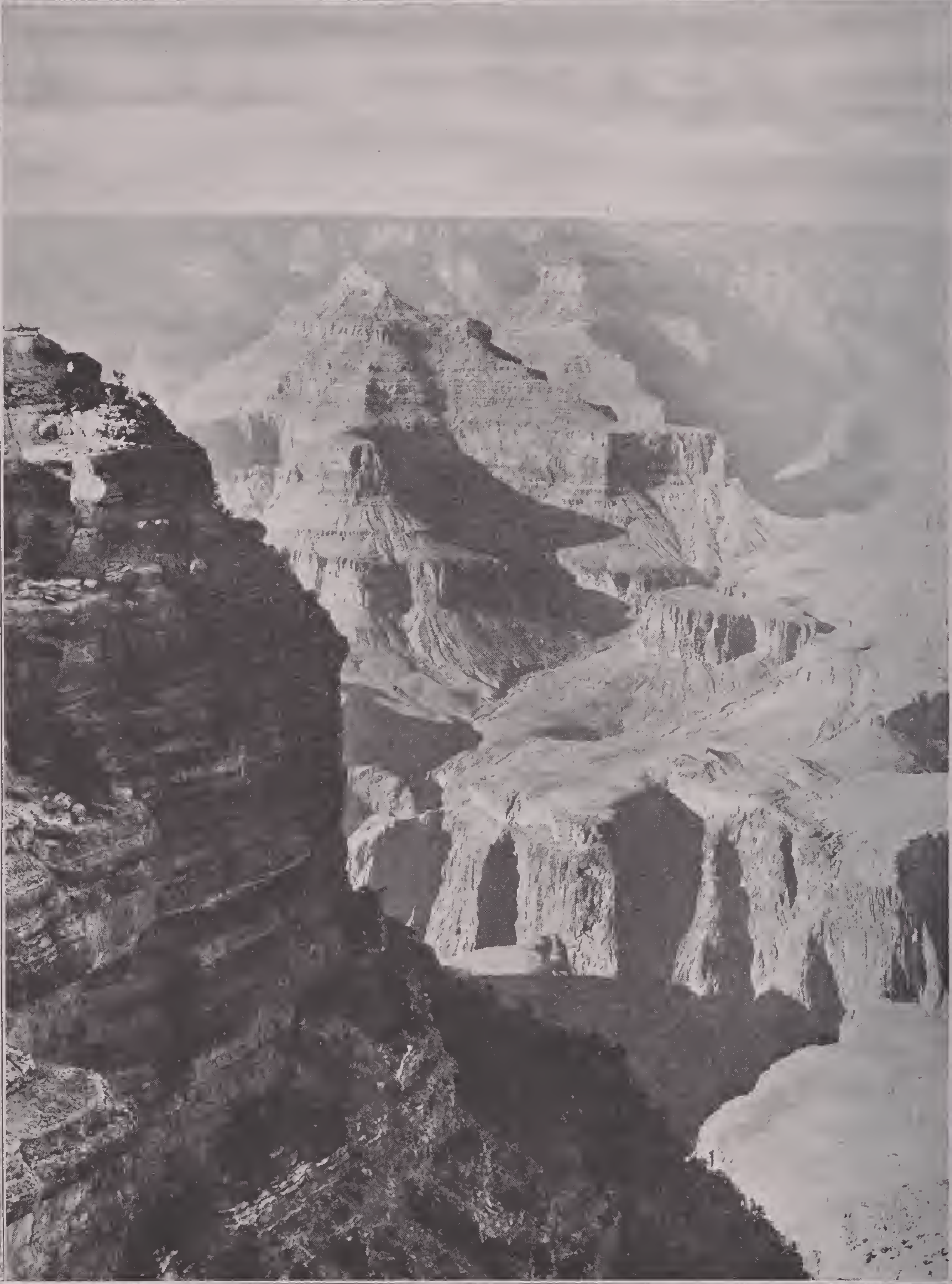
GRAND CANYON. When you stand on the rim of the 200-mile gorge cut by the Colorado River through the high plateau of northern Arizona, you are overwhelmed with awe. The Grand Canyon of the Colorado is the longest and deepest canyon in the world. It is Nature's greatest example of sculpturing.

THE ANCIENT PEAKS AND GORGES OF THE GRAND CANYON



This greatly reduced model brings into one picture the striking array of Nature's sculptures which make up the marvelous show spot of the American Southwest.

THE STUPENDOUS CANYON THAT BAFFLES DESCRIPTION



So stupendous, so incredibly vast and magnificent, is the Grand Canyon, that, as one writer says, "It has swallowed all the words in the dictionary suitable for describing the impression it makes on the eye, and it still remains undescribed." Here we see how the tributaries of the Colorado have cut up the original mass into the "temples" and buttes. Some ledges are red, some yellow, some gray. Purples and blues and greens appear in certain lights. The effect is like a great broken rainbow.

Look across the yawning depths of the stupendous chasm to the opposite wall, ablaze with bands of glowing colors. Peer over the edge, and far below you see what appears to be a tiny silver thread; it is the swift-flowing Colorado, one of the large rivers of North America. It looks so small because it is a mile below you. At the top its canyon is 8 to 12 miles wide.

From the rim to the river's brink the walls descend in a succession of cliffs and terraces, like a giant's staircase, each step several hundred feet high. The barren rocks of white, buff, dull red, and green have been carved into a bewildering variety of forms—buttes and pinnacles, alcoves and "Oriental temples" crowned by battlements.

The majesty of the Grand Canyon, which Charles Dudley Warner called "by far the most sublime of all earthly spectacles," is accentuated by a myriad of side gorges which join the main canyon from right and left. The region is "a composite of hundreds and thousands of gorges." Few have seen more than a tiny fraction of its wonders, for the journey through the length of the gorge is made extremely hazardous by the many rapids, in some of which the stream attains a velocity of 25 miles an hour. The first man to go through the canyon was Major J. W. Powell (1869), later Director of the United States Geological Survey, whose fascinating narrative of his explorations remains one of the classics of American travel.

Even the hardiest frontiersmen shunned the unknown perils of engulfing whirlpools, underground passages,and giant falls which Indian legend attributed to the canyon, until Major Powell organized a party of ten to thread the gorge from end to end. Hazardous enough the adventure proved, though the underground channels and giant falls were found to be myths. On the very day the journey ended, just before Major Powell and the faithful few of his band emerged into safety, four men deserted, hoping to scale the walls, and were never heard from again.

A reservation of 800,000 acres along the border of the Grand Canyon has been set aside by the United States government as one of the national monuments. A railroad spur runs to the most accessible part of the canyon, and hotels have been built on its brink. Thousands of visitors every year take the four-hour trip down trails to the bottom.

GRAND RAPIDS, MICH. When an American thinks of furniture he thinks of Grand Rapids, "the furniture capital of the United States." About 75 furniture factories are located there, and the annual output is enormous. While New York and Chicago exceed Grand Rapids in the volume of production of furniture, Grand Rapids is regarded as the leader in design, finish, and quality.

Twice a year furniture buyers from all parts of the United States and even from abroad come to this city to inspect new styles and place orders. These events have become so important that manufacturers from other cities also send their products to be displayed in huge exposition buildings erected for their use.

Grand Rapids is the metropolis of western Michigan and the second city of the state in population and importance. It is located about 35 miles from Lake Michigan, and is built on both sides of the Grand River, which affords steamboat connection with the lake ports. Though furniture-making is its chief industry, Grand Rapids is not by any means a one-industry town. It has metal-working concerns, machine shops, clothing and shoe factories, knitting mills, textile industries, paper mills, tanneries, and flour and feed mills. Much plaster is made from its rich gypsum beds under and near the Grand River. Grand Rapids supplies the world with carpet-sweepers and sticky fly paper. It is in the center of the famous Michigan fruit belt, and is one of the greatest peach markets in the world.

The city, which has followed a definite plan of city building, is very attractive. The park and playgrounds system includes more than 200 acres.

In 1826 an Indian trading station was established on the site, and the first permanent settlement was made in 1844, by the Dexter Colony from Herkimer County, N.Y. Grand Rapids was incorporated as a village in 1838 and as a city in 1850. It adopted the commission manager plan of government in 1917. Population, about 140,000.

GRANITE. If you look closely at a piece of granite you will see that it is made up of more than one kind of material, and if you crush it to powder you can easily pick out tiny fragments of the separate substances, or minerals, that compose it. The chief minerals are quartz, feldspar, and mica. The color of granite depends on the proportions and varieties of the minerals present. The prevailing color is gray,—light gray if dark minerals are few, dark gray if they are abundant. Greenish, pink, and red hues are due to different kinds of feldspar.

Granite belongs to the group of "igneous" rocks—that is, it was formed ages ago by the cooling of liquid lava. This cooling took place far below the earth's surface and very slowly, thus giving plenty of time for the formation of crystals. Granite belongs to no particular geological age, but was formed in all periods and may be forming now far below the earth's crust. It is one of the most widely distributed of rocks, occurring in the United States mainly in mountainous regions.

Fresh granite is a very hard stone, but like other rocks it may decay and crumble to pieces. Because of its great hardness it is difficult to work, and so is an expensive building stone. It is used chiefly for paving blocks, for monuments, and for large buildings, where great strength and durability or beauty of finish are required. Many of the varieties are exceedingly beautiful in coloring and take a high polish.

The hills and mountains of New England supply us with much of our granite; Vermont, Massachusetts, New Hampshire, and Maine being large producers. Other important quarries are found in North Carolina, Minnesota, Wisconsin, and California.

The HERO *of* APPOMATTOX, *in* WAR *and in* PEACE

ULYSSES S. GRANT

GRANT, GEN. ULYSSES S. (1822–1885). When the news that Fort Sumter had been fired on was flashed over the wires, in April 1861, meetings were held in every city and village in the North, and volunteers by thousands offered their services in defense of the Union, even before President Lincoln issued his first call for troops. At a meeting in Galena, Ill., a middle-aged clerk in the hardware and leather store of Jesse Grant came forward and offered to help recruit a regiment. This man was Ulysses S. Grant, a graduate of West Point, who had served with distinction in the Mexican War and had resigned from the regular army with the rank of captain.

Born on April 27, 1822, on a farm near Point Pleasant, Ohio, the boy was named Hiram Ulysses. An error in his papers when he entered West Point Military Academy in 1839 dropped the Hiram and inserted Simpson, his mother's maiden name. He reported the error, but it was never corrected, and eventually he adopted the name as changed. But his son, U. S. Grant, Jr., reports that the "S" was always written without a period, and that while it may have meant "Simpson," it was never so written.

Upon his graduation in 1843, Lieutenant Grant was sent to Jefferson Barracks, Mo., and thence to the Mexican War, where he won two brevets for bravery. In 1848 he married Julia B. Dent, the sister of a classmate, in St. Louis, and saw several years' service in the Far West in pioneer days. In 1854 he resigned and retired to a farm near St. Louis, later opening a real-estate office in the city. But in business Grant was a failure. He got into debt, and was glad to take a place as clerk in his father's store in Galena.

A Man of the Bull-Dog Breed

In May 1861, Grant was appointed colonel of the 21st Illinois Infantry, and in August he was made brigadier-general of volunteers and given command of southwestern Missouri, with headquarters at Cairo. From the start Grant's policy showed the aggressiveness which marked his whole career. He at once took possession of Paducah, Ky. On November 1 he routed the Confederate garrison at Belmont, Mo., a result which checked the advance of a Confederate force under General Price. In February 1862, he captured Fort Henry on the Tennessee and Fort Donelson on the Cumberland. While he was besieging the latter the commander of the fort, General Buckner, asked for terms of capitulation, to which General Grant replied: "No terms other than an unconditional and immediate surrender can be accepted." Buckner surrendered the fort with over 14,000 prisoners, and Grant became famous as "Unconditional Surrender" Grant. This important victory broke the Confederate lines, and secured Federal control of western Kentucky and Tennessee.

Grant was now made major-general of volunteers and given command of western Tennessee. On April 6 he fought the battle of Shiloh, one of the bloodiest engagements of the war. He was severely blamed by the people of the North for the heavy loss of life in this battle, and many demanded his removal from command. But President Lincoln steadily upheld him, saying, "I can't spare this man, he fights." During the summer he fought the minor battles of Iuka and Corinth.

Then Came the Fall of Vicksburg

He then turned to the capture of Vicksburg, which would open the Mississippi River. His first advance on the city, poorly planned and complicated by political intrigues, proved a failure. But Grant remained in the neighborhood with his army, and after trying one plan after another without result, his perseverance was at length rewarded. After a daring campaign, in which his generalship and his energy were more conspicuous than ever, he besieged the city, and at the end of six weeks this stronghold, with its garrison of 32,000 men, was surrendered (July 4, 1863).

Grant's next campaign was for the relief of Chattanooga, where the Federal army, beaten at Chickamauga, was besieged and practically cut off from supplies. On November 23 to 25 the battles of Lookout Mountain and Missionary Ridge were fought, resulting in the defeat of the Confederates.

In March 1864 Grant was made lieutenant-general and placed in command of all the Union armies. He now planned a wide campaign which should press the Confederates simultaneously at all points east and west. Leaving Sherman to fight Johnston from Chattanooga to Atlanta, he himself with the Army of the Potomac confronted the Confederates under General Lee. The clash of these great leaders came in the terrible battles of the Wilderness, Spottsylvania, North Anna, and Cold Harbor. Finally came the siege of Petersburg, which ended in its fall, the capture of Richmond, and the surrender of Lee at Appomattox, April 9, 1865. Grant's generous terms of surrender and his courteous treatment of his late foe won the heart of the South. At a later time he even threatened to resign his command if President Johnson had Lee tried for treason.

The war was over. Grant went immediately to Washington to hasten the disbanding of the army. He was created general, a higher rank than had hitherto existed in the army, and was hailed as "the man of destiny" and "the nation's deliverer." As such, he was elected president in 1868 on the Republican ticket, with Schuyler Colfax of Indiana as vice-presidential candidate, against Gov. Horatio Seymour of New York, the Democratic candidate.

"The man on horseback" is not always a successful executive. General Grant's inexperience in civil administration was conceded and his lack of political ability was soon to be shown. But his strong will was known and also his rugged patriotism. He possessed the confidence of the people, and this was increased by the negotiation of the Washington treaty with England, which defined the rights and duties of neutral nations in time of war and arranged the arbitration of the *Alabama* claims. His attempts failed, however, to bring about the annexation of San Domingo to the United States.

GRANT'S ADMINISTRATIONS
1869–1877

Treaty to annex San Domingo defeated (1869).
15th Amendment enfranchising Negroes ratified (1870).
Last of seceded states restored (1870).
'Alabama' Claims referred to arbitration (1871).
Amnesty Act for ex-Confederates passed (1872).
Great fires in Chicago (1871) **and Boston** (1872).
Panic of 1873.
Bill to increase paper money vetoed (1873).
"Salary Grab" raises Congressmen's salaries (1873).
Postal cards first issued (1873).
"Whisky Ring" scandal exposed (1874).
Custer Indian Massacre (1876).
Colorado admitted (1876).
Centennial Exposition at Philadelphia (1876).
Disputed Election of 1876.

The most important domestic problem of Grant's administration was the completion of the reconstruction of the South and the adoption of the 15th amendment.

In 1872 President Grant was overwhelmingly reëlected, with Henry Wilson of Massachusetts as his running mate, in spite of the opposition candidacy of Horace Greeley, the noted editor of the New York *Tribune*, who ran on a Liberal Republican platform. At the beginning of his second administration Grant had to face the financial crisis of '73. Here he rendered an inestimable service to the country by vetoing a bill for issuing more "greenback" paper money, and by recommending that the government "resume specie payments" by redeeming its greenbacks in gold. The coinage bill passed the same year was later denounced as the "crime of 1873," because, by dropping the silver dollar from the list of standard silver coins, it "demonetized silver." His policy, however, was unquestionably in line with the best interests of the country.

The last years of Grant's presidency covered the lowest ebb ever reached in the political life of the country. High public officials allowed contractors to cheat the government out of millions of dollars, and themselves profited by the bribes given them. There were grave scandals connected with government aid to the Union Pacific Railway, and the phrases "Credit Mobilier," "Whisky Ring," and "Star Route," became synonyms for dishonesty. But in all the political corruption and scandal, no one imputed personal dishonesty to the President. He was unfamiliar with the intricacies of business and finance. His fault lay only in trusting those who were unworthy of trust and in trying to protect his friends.

In 1877, after his retirement from the presidency, General Grant made his famous tour of the world, in which Occident and Orient competed to do him honor. The attempt to secure for Grant the Republican nomination in 1880 for a third term failed in spite of strenuous efforts put forth by the "stalwart" Republicans.

At the age of 56, a man of established fame, Grant invested his capital in the banking firm of Grant and Ward, New York City. With his usual trust in his associates and his ignorance of business, General Grant left the conduct of the enterprise to his partners, who proved dishonest. Through their dishonesty the firm failed, and Grant was left penniless. A fall had crippled him, so that, at this time and until his death, he had to use a crutch.

Nothing in all the career of this great American is so heroic as the closing year of his life. Bankrupt, crippled, dying of cancer of the tongue, he dictated two volumes of 'Memoirs' to provide for his family. When it was absolute agony to speak, with a fortitude and unselfishness that have few parallels in history, he continued his task, completing the work only four days before his death, at Mt. McGregor, near Saratoga, N.Y., on July 23, 1885. Even as literature the 'Memoirs' have a singular merit, on account of their clear, straightforward style. The magnificent tomb erected to Grant's memory in Riverside Park, New York City, is the tribute of a grateful nation to the man to whom was chiefly due the military successes which preserved the Union.

GRAPEFRUIT. Did you ever wonder why a fruit as large as a croquet ball should be called a "grapefruit?" The answer is evident when you walk through a grapefruit orchard in the southern parts of Florida or California during the bearing season. You will see the heavy fruit hanging in grapelike clusters of from three to 18, weighing down limbs and tree until they must be propped up.

The grapefruit belongs to the same species of the citrus family as the shaddock, a coarse bitter pear-shaped fruit weighing from 10 to 20 pounds, which is a native of the Malay Archipelago and the South Sea Islands. The best varieties of grapefruit are about twice the size of a large orange.

A LUSCIOUS CLUSTER OF GOLDEN GRAPEFRUIT

Isn't it strange that although this delicious fruit came to America with the Spaniards several centuries ago, we only began eating it in recent years? Meanwhile how many thousands of these golden globes rotted in the sun, because people didn't realize how good they were!

The grapefruit (also called pomelo) has an interesting history. Only since the early part of the 20th century has it been marketed to any extent, although it was brought to the West Indies and Florida by the Spaniards along with the orange and lemon. The tree is very beautiful, with dark glossy leaves, downy white beneath, and large sweet-scented blossoms which are succeeded by the great clusters of lemon-yellow fruit. The tree was long cultivated in Florida gardens for show. Its fruit was considered refreshing and tonic, but it did not enter the minds of the growers that it had a commercial value. So the ground beneath the trees, after the fruit had ripened, was covered with the great juicy yellow balls, left to rot in the sun.

Northern visitors to Florida learned to like the grapefruit and wanted it on their return, and in this way a certain demand was created for it. Between 1880 and 1885 the first shipment was sent to New York and Philadelphia, and a market was established, at first slowly, then more rapidly.

In no place in the world has the culture of grapefruit reached such perfection as in Florida, and it now constitutes a very important crop in that state. The groves near Miami are one of the sights for winter visitors. Its cultivation has been extended also to California, Jamaica, and Cuba.

As a breakfast fruit grapefruit has no rival. It is an excellent appetizer and its characteristic flavor, which is an indescribable blending of sweet, sour, and bitter, is most pleasant. There are several varieties, the best known being Duncan, Marsh seedless, and Walters.

The tree is small, growing to a height of only about 25 feet, and is less susceptible than the orange to pests and diseases. It is more susceptible than oranges or lemons, however, to an infectious disease called citrous canker. The infection causes scabs to appear on the leaves and fruit.

The grapefruit is usually budded on its own stock or on the sour orange. The tree is a heavy bearer and bears as early as the orange—in about six years—but it is more easily injured by cold, and is grown only in the southern parts of Florida and the warmer portions of California. Scientific name, *Citrus decumana*.

The FRUIT *of the* VINE *and Its* STORY

How All Our Purple Concords Came from a Single Seed—Why the Famous French Vines Have American Roots—Grape Seeds that Are 3,000 Years Old

GRAPES. Until a little more than a hundred years ago, the only grapes grown in the eastern United States were the little sour wild grapes you so often see growing in the woods. All the delicious varieties of the eastern United States today, from the tiny reddish Delaware to the great yellow-white Scuppernong, have been developed by careful selection and cultivation from these wild grapes; and most of them have come from one species,—the fox grape.

Take the fascinating story of the rich purple Concord grape, for example. In the year 1840 some boys of Concord, Mass., spent a glorious day gathering wild grapes in the nearby woods. On their way home they threw some of the seeds on the land of Ephraim Bull. Mr. Bull preserved one of the seedlings that sprang up, and three years later when it fruited he planted its seeds. One of the second generation of plants proved much superior to the others, so he destroyed the rest and preserved this, which became the parent of the countless Concord grape-vines of the eastern United States—the kind that supplies us with most of our table grapes.

A story much like this is behind all the other luscious native grapes of the United States, which now include about 800 varieties. The first "truly American grape" was the small sweet reddish Catawba, which has remained one of the most highly prized varieties ever since its discovery near the Catawba River in North Carolina, in 1802. The fine-flavored Isabella and Delaware were also among the earliest native American varieties to be developed.

While the United States has more than two dozen kinds of wild grapes, nearly all the 1,500 varieties developed in the Old World, through thousands of years of cultivation, come from one parent stock. But if you visit the famous vineyards of France you will find that many of them consist of European vines grafted on the root of some American vine. And thereby hangs another of the interesting stories connected with the work of grape culture.

When the early settlers came to the eastern coast of America they brought with them cuttings from the grape-vines of Europe, but the plants all died. It was not until more than two centuries later that scientists discovered that this was due to the ravages of an insect pest, the grape phylloxera, which sucks the sap from the roots of the vines (*see* Aphids). This insect multiplies with such terrific rapidity that a single mother, after laying her eggs in March, might have 25,000,000 descendants by October if they all survived. In 1860 some of these deadly pests were carried to France on American vines with which French growers were experimenting. In a few years the whole grape industry of France was threatened with destruction. By 1888 the devastations had reached such gigantic proportions that it had cost France two billions of dollars —twice as much as the indemnity exacted by Germany at the close of the Franco-Prussian War of 1870–71. Remedy after remedy was tried with little success. The pest was finally checked by introducing American vines, which centuries of exposure to the phylloxera have made immune to its ravages. The various famous Old World varieties were grafted on these American roots, so that the grape remains the same though growing on a different root. Similar measures have been adopted, though to a less extent, in nearly all the vine-growing countries of the world.

Even on the Pacific coast of the United States, where the phylloxera was formerly unknown, it has been necessary to replace many vineyards with European vines grafted on American stocks. In California, which produces about three-fourths of the entire American crop, the common European grape has thrived ever since the days of

A MIRACLE OF PLANT TRAINING

No more striking example of the wonders of horticulture can be found than the development of such grapes as this from the little sour wild grapes of the woods. Under man's care, these fruits of the vine have grown sweet and swelled so in size that they crowd one another on their stem.

the Spanish missions, and from it many new delicious varieties have been developed. Among the best known are the Flame Tokay, Emperor, Cornichon, Muscat, and Thompson's Seedless. Some of the California crop is shipped as table grapes to various parts of the United States, but most is used for making beverages, for canning, for jams and jellies, and for raisins (*see* Raisins).

Grapes have furnished men with food and drink since the dawn of history. Grape-seeds have been found with mummies in Egyptian tombs at least 3,000 years old, and it is believed that the grape was the first fruit to be cultivated. The original home of the vine was Asia, whence it was brought to Europe probably by the Phoenicians.

The distinctive colors of grapes are entirely in the outer skin, which may be green, red, yellow, purple, or even variegated. Sometimes grape-vines remain fruitful for 300 or 400 years.

Wines are made by fermenting the juice of the grape. During fermentation a grayish or reddish crust forms in the vat, and this crystalline substance, "argol," refined becomes the "cream of tartar" used in medicine, in effervescent drinks, and in baking powders.

The chief grape-growing districts in the United States, outside California, are the Hudson River valley, the lake regions of central and western New York, northern Ohio, southern Michigan, and the Ozark region of Missouri. The great bulk of the eastern crop consists of three varieties—the Concord, Catawba, and Delaware. (*See also* Currants).

Scientific name of European grape, *Vitis vinifera;* American fox grape, *Vitis labrusca.*

GRAPHITE. In appearance graphite is so different from the diamond that it is at first difficult to believe that the black opaque soft graphite is chemically identical with the colorless transparent precious stone, the hardest of all known substances. But, like the diamond and coal, graphite is one of the many forms in which the extremely useful element carbon is found.

One of the familiar uses of graphite is for the "leads" of black pencils. Because it is a good conductor of electricity it is also much used in electrotyping and electrical apparatus. Graphite makes an excellent lubricant, since the countless minute flakes of which it consists easily adhere to rough metal, producing a smooth surface and reducing friction. But most of the world's production is used with clay and sand to make the crucibles and retorts which do not melt under the most intense heat. Other important uses are for paints and stove polish.

Graphite of the highest purity is now artificially made in electric furnaces at Niagara Falls, N.Y., where the annual production is more than 13,000,000 pounds. Ceylon is the world's largest producer of mined graphite. Madagascar, Korea, Italy, Mexico, and the United States also produce important quantities. The principal sources of supply of "amorphous" or soft graphite in the United States are Colorado, Michigan, Nevada, and Rhode Island. Of crystalline graphite, the most important variety, the United States imports more than it produces, though this form also is mined in Alabama, Alaska, California, Montana, New York, Pennsylvania, and Texas.

GRASSES. There is a fable of a magic carpet that carries one to wealth and the world's wonders. Grasses—the most important and useful family of the whole vegetable kingdom—are such a magic carpet for earth's surface. Wild and cultivated they are the greatest contributors to the needs of human and animal life. A large portion of our food is provided by cultivated "grasses"—wheat, oats, rye, barley, rice, corn, sorghums, and sugar cane; and from grasslands in the ordinary sense come our beef and mutton, hides and wool.

Grasses are the most widely distributed of all the plant families. Pigmy grasses, mosslike grasses not over two inches high, cling close to the cold ground right up to the borders of the field of ice and snow. The giants of the family are the bamboos growing 100 feet tall in the burning heat of the tropics, and other tall species form the impenetrable "canebrakes" of the South where many fishpoles grow. Such "reeds," as they are often called, are used in furniture making, especially in "cane"-seated chairs. Small and middle-sized grasses, growing in greatest luxuriance in the north temperate zone, increase the total of the family to over 4,000 species. In the United States alone there are over 1,000 species, and there may be as many as a dozen in one dooryard. Grasses grow, or can be made to grow, on all kinds of soil and in all sorts of conditions. They thrive on the banks of streams, along the seashore, in the low wet marshlands, on the sunny meadows, or in the shade of woodland and orchard. Some varieties, such as the sweet vernal grass, June grass, and orchard grass, are the first out of bed in the spring; others, like timothy, redtop, and

STURDY PIONEERS OF THE GRASS FAMILY

Here we see how the Lyme grass (*Elymus arenarius*) continually pushes on, sending up shoots from its creeping rootstock. Such grasses make their way along sandy seacoasts, binding the sand together, and preparing the soil to receive less sturdy vegetation.

hair grass, flourish in midsummer; and even fall has its grasses—the beard grass and the dropseed grasses of September.

The grasses can boast of their long ancestry, for they belong to one of the "first families" of the Vegetable Kingdom. As far back as history can go, grasses were growing in abundance. Just as today, they were among the first of plants to cover waste or barren ground and reclaim a neglected roadway or field.

One of the most important things grasses do is to bind down the soil until plants of larger and slower growth can establish themselves, and even then the grasses protect the roots of trees and our fences, roads, and buildings by forming a thick enduring carpet which prevents the wind and rain from carrying away their soil foundation or from blotting them out and burying them under shifting sands. In winter the grasses, changed from their beautiful green to colors of gold and brown, give protection to the seeds and tender bulbs during their long sleep under the snow.

The World's Greatest Pasture-Lands

The great natural pasture-lands of the world are the steppes of Russia, the pampas of South America, the vast plains of America, and the wide ranges or "runs" of Australia. Practically every farm has its pasture-land and the reason is easily understood. Fattening beef cattle, which would cost 20 cents on a ration of grain and roughage, costs only three or four cents a pound on pasture-land, and a cow pastured at a cost of three to five cents a day will give as much milk as when fed on grain and hay at three or four times the cost.

Grasslands of greatest perfection are lawns, especially the lawns of England and other old countries where they have been rolled, trimmed, and regularly watered for centuries. Lawn or pasture grasses have leaves that grow constantly from their bases so that when they are grazed or clipped they quickly grow up again. There are a number of ornamental grasses such as the ribbon-grasses, plume grass, Ravenna grass, Job's tears, and the tall plumed Argentine pampas.

Winners in the Race of Life

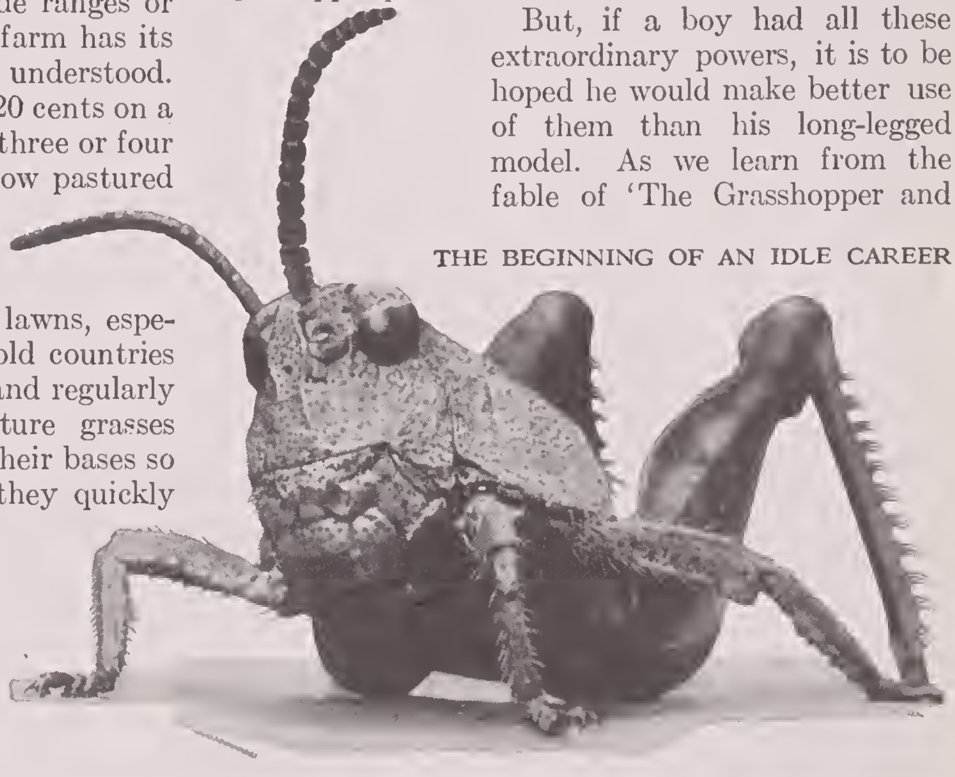
Grasses are well fitted for making their own way in the world, and if for any reason they are not wanted they become a most persistent weed, like the blue grass and quack grass which are among the worst weeds of our fields. Numerous are the devices for spreading their seeds, and grass plants are multiplied many times by growths from stolons or stems running along the ground, underground stems, and multiplying bulbs. Grasses are rapid growers, the larger species growing two or three feet and even more in 24 hours, and the 100-foot bamboos grow in from two to three months' time. Another special advantage which many of the grasses have is a peculiar structure of their leaves which protects them from drouth. Thin-walled cells between the veins of the leaves keep them expanded under normal conditions but roll them up to prevent evaporation while drouth and hot winds threaten.

The botanical name of the grass family is the *Gramineae.* The plants are monocotyledonous, and their chief characteristics are the jointed stems with leaves arranged in two opposite rows, a single leaf at each joint of the stem. The stems are hollow except in corn, sorghum, and a few other varieties which have stems filled with soft pith. The leaf is a long narrow blade with its base inclosed in a sheath out of which it grows. The flowers are inclosed in glumes or chaff-like scales and are arranged in spikes like the wheatheads or in panicles like the oat. They depend upon the wind to scatter their pollen and do not have color or perfume to attract pollen-carrying insects. Clovers, alfalfa, and other plants which are grazed or cut for hay are often called grasses, although they are not true grasses.

GRASSHOPPER. If a boy could jump as far for his size as a grasshopper, he could easily spring to the roof of an eight-story building, or cover a long city block in two comfortable leaps. If he could make as much noise for his size as a grasshopper, the ground would tremble with the sound, and if he could eat as much and as fast as a grasshopper, he'd have to dine upon apple pies the size of cart-wheels.

But, if a boy had all these extraordinary powers, it is to be hoped he would make better use of them than his long-legged model. As we learn from the fable of 'The Grasshopper and the Ant', this foolish insect does no useful work, lays by nothing for the future, and wastes its time in tuneless song. In addition to these shortcomings, it has a greedy appetite for most of the things men grow in their fields and gardens. So it is classed as a pest, and has no friends except the birds and fish that feed upon it.

THE BEGINNING OF AN IDLE CAREER



This is a much magnified view of a young King Grasshopper, just starting out in life. While he probably hasn't done much harm so far, it is very much to be feared he will follow the old family traditions of the grasshoppers and spend his days buzzing in the sunshine or devouring the farmer's crops.

Everyone is familiar with the small green variety of grasshopper, which, as the name indicates, is usually found hopping aimlessly in the grass. With a quick hand they are easily caught, but if not held

WHEN THE LOCUSTS COVER THE LAND

Three hours before the picture was taken this field of wheat in the Transvaal, South Africa, was billowing in the breeze. Then a cloud of locusts appeared on the horizon, spread until the sun was darkened, and the air was filled with the humming of their wings. They settled down on field after field, covering them like living blankets, as you see in this picture, and the wheat was mowed down by millions upon millions of hungry jaws.

tightly will kick themselves loose with those powerful high-angled back legs. At the lower side of their helmet-shaped heads are the strong jaws with which they tear big pieces out of leaves or plant stems. When annoyed they will often spit out a brown liquid. Their front wings, which are tough and hard, lie straight along their backs, protecting the tender film of the back wings.

MOTHER GRASSHOPPER LAYING HER EGGS

The female Grasshopper with that drill of hers — the ovipositor — bores a hole in the ground sometimes four inches deep. There she lays her eggs. In the hole at the left the eggs have hatched and the young are crawling out. At first, they look not unlike large ants and they spend the two weeks or so before their wings come out eating enormously. The long ovipositor, as well as the long antennae, serve to distinguish the true grasshoppers from the locusts.

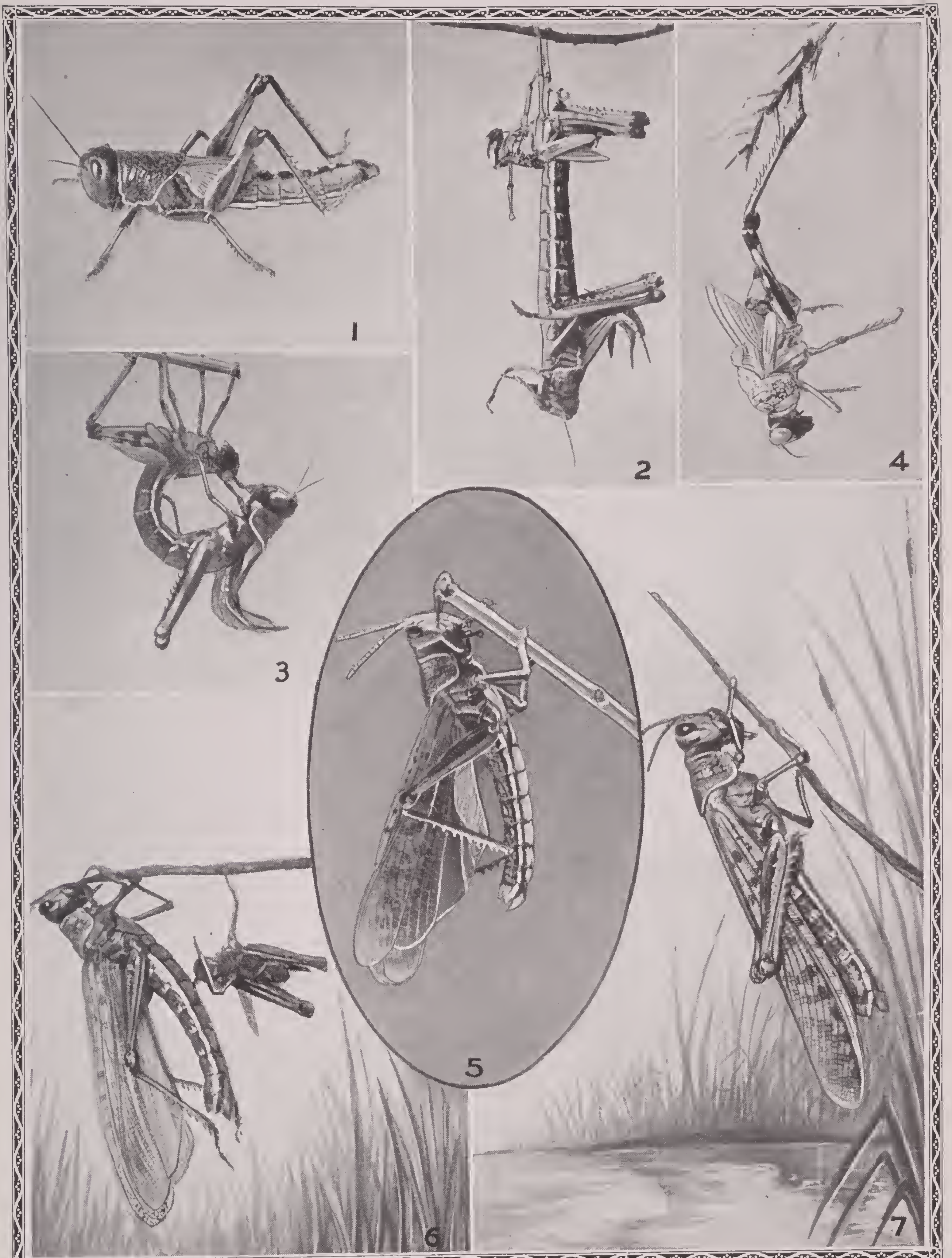
The reason the grasshopper can't "sing" while you're holding it is that its "voice" is under its front wings, which it rubs against its body when it wants to be heard. Also, don't look for the grasshopper's ears on its head; they are on its front legs below the first joint.

Now imagine a grasshopper nearly four times as large as this one, with legs, jaws, and wings in proportion, and you will realize what the dreaded locust of Asia and Africa is like. This name "locust" is often improperly applied to the cicada, and to other swarm insects, but it properly belongs only to members of the grasshopper family.

A swarm of locusts which devoured the grain and left famine in its wake was one of the "seven plagues" of Egypt, told of in the Bible. Well, the descendants of those same locusts are still alive today.

It is impossible to give an idea of the billions upon billions of locusts which sometimes travel in these swarms. A cloud appears on the horizon like a black storm; it spreads until the light of the sun dies out; the air is filled with the deafening roar of countless wings. The inhabitants rush from their huts and raise their hands to heaven, praying the cloud will pass. But it settles down like a vast blanket, burying every-

HOW THE LOCUST GETS ITS WINGS



1. The young Locust, a few days after hatching, its wings folded inside little cases on its back. 2. Shedding its "nymph" skin. 3. Almost out of the shell. 4. The old shell left hanging to a twig. 5 and 6. The locust drying and smoothing out its wings. 7. Resting after its first trial flight.

thing in sight, blotting out the landscape—for miles upon miles, nothing but a sea of locusts. Then the fatal march of the insect army begins. Before it stretch green fields; the dense column moves forward, and the green fields vanish. Behind the locusts, the ground looks as if it had been swept clean with a vast broom—not a spear of grass, nothing. A river bars the way. The front ranks fearlessly cast themselves upon the water, clinging together, pile upon pile, until a bridge of living insects forms, and the rear ranks march on to their work of destruction.

Mystery of the Locust Plagues

There is mystery in these swarms. They do not come every year, nor do they always attack the same region. No one knows what instinct moves them to these sinister travels, nor where they intend to go. Swarms have settled upon ships 1,200 miles at sea.

In the United States the smaller Rocky Mountain locusts are the chief pest of the grasshopper family. Born in the mountain regions of the West, they descend in swarms upon the fertile plains of the central states, doing immense damage. The names "locust" and "grasshopper" are freely interchanged in popular usage between almost all members of the grasshopper family. But scientists make a distinction between the "long-horned" and the "short-horned" varieties.

The swarm locusts just described belong to the short-horned group, which includes also the brown field grasshopper with the stout red legs. The common green grasshopper, however, has long thread-like feelers and belongs to the long-horned group. The short-horned grasshoppers are also distinguished by having the noise-making apparatus between the hind legs and the wings, and the ears on the sides of the stomach, just behind the chest or thorax.

Where Grasshoppers Lay Their Eggs

Grasshoppers usually lay their eggs in holes which the females bore in the ground. When the young hatch, they look like tiny awkward models of their parents, except that their wings do not develop for some time. Their appetite, however, is large and they start at once their destructive feeding.

Many locusts seem to require a sandy desert soil for laying their numerous eggs, so that, fortunately, the more pernicious varieties tend to disappear with the advance of civilization. In ancient times locusts were often eaten by Asiatic and African peoples, and the custom still survives among certain desert tribes. The insects are usually roasted or baked, and then ground into a powder, which is mixed with flour for bread.

Scientific name of grasshopper order, *Orthoptera*. By a freak of insect classification, the name *Locustidae* has come to be applied to the long-horned variety, such as the small green grasshopper, while those commonly called locusts belong to the group named *Acridiidae*. Scientific name of Rocky Mountain locust, *Melanoplus spretus;* common green grasshopper, *Locusta viridissima*. The common katydid is also a member of the grasshopper family. (*See* Katydid.)

The FORCE *that Holds the* UNIVERSE TOGETHER

Story of the Mysterious Attraction that All Things Have for One Another—Why Bodies Fall Down and Not Up—"Weight" and What it Means—The Discoveries of Newton and Galileo

GRAVITATION. From the beginning of time a very remarkable thing has been happening, and few except very little children and very great philosophers have thought to ask why. That is, things have invariably been falling to the ground, and never in any other direction. Everything on the earth tends to fall, or to seek a lower position, unless held up by something beneath it. Even balloons and corks are not the exception that they seem to be. The force which causes bodies to act in this way we call "gravitation."

But is gravitation a mere local affair? What about other worlds than ours? More than 250 years ago a young man named Isaac Newton was walking in an English orchard wondering what the power is that keeps the moon forever swinging in its orbit around the earth, like a ball at the end of a string that a child keeps whirling around. Seeing an apple fall from a tree, he asked himself (so runs the story) if the same force which is so irresistible and so all-pervasive on earth might perhaps be the force that keeps the moon in its orbit by constantly pulling it toward the earth. Might not terrestrial gravitation be only one manifestation of a great universal Law of Gravitation, ruling not merely the fall of terrestrial things, but all motion in the universe—even the stately swing of the planets about the sun and of other stellar systems out to the uttermost bounds of space?

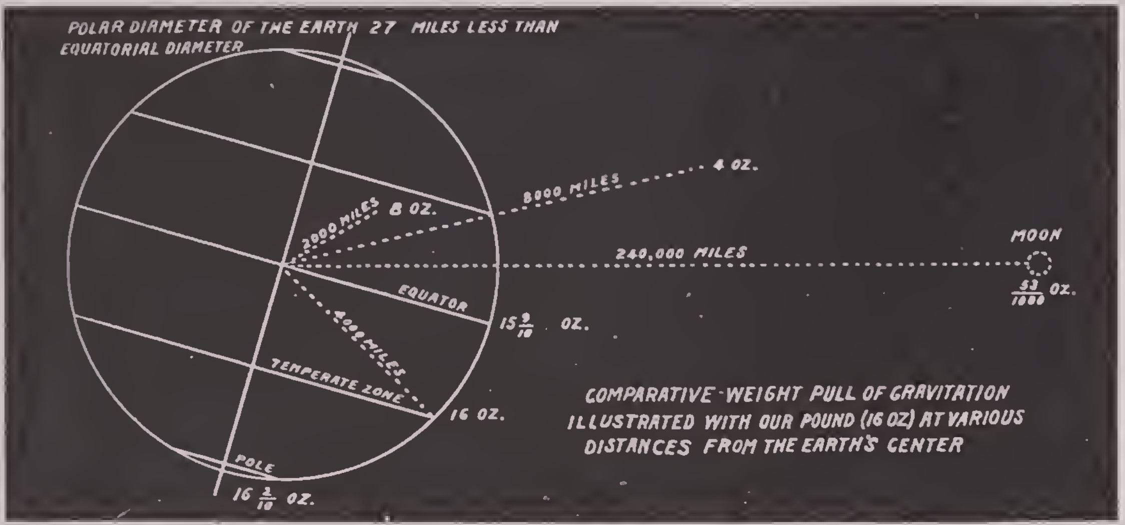
Now Isaac Newton was not the first man to whom such an idea had occurred. The great mathematician and astronomer Ptolemy of Alexandria had surmised something of the kind in the 2d century A.D.; and others since that time had had vague inklings of the existence of the great and splendid force divined by Newton. It's a long way, however, from vague surmises to sound scientific theory based on proof, but the materials for such proof had been gradually accumulating from Ptolemy's time to Newton's. He attempted to put his theory to the test of calculation, but his results did not agree with the moon's observed course, and he laid by the idea for years. At length more accurate figures were obtained for the distance of the moon from the earth, and when these figures were used the calculation of the action of gravitation on the moon was found to agree exactly with the moon's course, and similar calculations applied to the other heavenly bodies completed the chain of evidence. Gravitation was proved.

HOW A LITTLE APPLE STARTED A BIG IDEA

It was a great day — one of the greatest days in the whole of science — when Sir Isaac Newton, sitting in his garden at Lincolnshire, noticed an apple fall to the ground and asked himself, "Why?" The answer of a common mind would have been "Because it can't help it." But in the fertile brain of this great man the seed of a great thought was planted, and step by step he worked out the Law of Gravitation.

The great law of gravitation which Newton thus established is that *every mass of matter attracts every other mass of matter with a force which varies directly as the product of their masses and inversely as the square of the distances between them.* Observe, the attraction is mutual; if the earth attracts the grain of sand, the grain of sand attracts the earth. So the planets pull the sun while the sun pulls them. This relation of the pulling power of gravitation to mass implies some rather surprising things with regard to conditions on other planets, which may be found in the article on Planets.

HOW GRAVITY'S "PULL" AFFECTS WEIGHT


POLAR DIAMETER OF THE EARTH 27 MILES LESS THAN EQUATORIAL DIAMETER
8000 MILES
4 OZ.
2000 MILES
8 OZ.
MOON
240,000 MILES
$\frac{53}{1000}$ OZ.
EQUATOR
$15\frac{9}{10}$ OZ.
4000 MILES
TEMPERATE ZONE
16 OZ.
COMPARATIVE-WEIGHT PULL OF GRAVITATION ILLUSTRATED WITH OUR POUND (16 OZ) AT VARIOUS DISTANCES FROM THE EARTH'S CENTER
POLE
$16\frac{2}{10}$ OZ.

This diagram shows how the pull of gravity varies at different distances from the Earth's center. The unit of comparison is 16 ounces (one pound) weighed in the temperate zone. The general law is that the farther the object is from the center of the Earth, the less it weighs. Because the Earth bulges a little around the middle and is flattened at the ends, the pound will *lose* weight as you move it toward the Equator and *gain* weight as you move it toward the Poles. If the pound were taken to the Moon, the Earth's pull upon it would be only a fraction of an ounce. At a depth of 2,000 miles in the Earth, the pound would weigh only eight ounces. This seems to violate the law about "the nearer the center, the greater the pull." But remember that now the 2,000 miles of earth *above* our pound weight would be tending to pull it *upward,* thus counteracting a part of the *downward* pull.

The most important step in the study of gravitation on the earth, before Newton formulated his law of its universal action, had been taken about a century earlier. For nearly 2,000 years men had been repeating the dictum of the great Aristotle that heavy objects fall more swiftly than light ones, and that the rate of speed is in proportion to the weight of the object. Not until the end of the 16th century was anyone so impertinent as to try to find out whether Aristotle could have been mistaken. Then an inquisitive young man named Galileo climbed the Leaning Tower of Pisa and dropped from the top two objects of different weights. They struck the ground at the same time! And great was the scandal thus created among the wiseacres, who wanted to know what the world was coming to, if a mere nobody were to be allowed to dispute the word of the infallible Aristotle!

But Galileo must needs experiment further, and find out that falling bodies constantly acquire more speed the farther they fall. An apple falling from the limb of a tree 16 feet above the ground strikes the ground in one second, and one dropped from a tower window 64 feet high strikes the ground in two seconds. In other words, a falling body drops 16 feet in the first second, 48 in the next, and 80 in the third—or 144 feet in the first three seconds. Every second that a body falls, it gains 32 feet over the speed it had the second before. Otherwise stated, the Law of Falling Bodies is that the distances traversed by any falling body from the beginning of its fall to any two or more points during the fall are to each other as the squares of the times in falling.

That is why you can fall from a chair to the floor without hurting yourself much, while, if you were to fall from the roof or upper window of a high building, you might break most of your bones, even if you were lucky enough not to be killed. When you strike the floor in falling from the chair, you are still moving comparatively slowly, while by the time you strike the ground in falling from the roof, you are moving with terrific speed. This is also why it is so much more dangerous to be struck by a brick or a stone dropped from a great height than by one which has fallen only a short distance.

The strength of the earth's pull on each object is the weight of that object, and since the strength of the pull diminishes as the distance increases, the weight of the same object varies at different points on the earth's surface. If you were to weigh five pounds of lead—or wood or cotton or anything—carefully on a spring balance at one of the poles, and then take it to the Equator and weigh it again on the same scales, you would see it stretch the spring a very little bit less, because it is farther away from the center of the earth. Likewise, you would find that the same object weighs less on a high mountain top than at sea-level, the difference being about 1/2,000 of the weight for every two miles of elevation.

Furthermore, the weight of an object is in proportion to its mass, that is, the amount of matter it contains. Two lead balls of the same size would not weigh the same, of course, if one were solid and the other hollow. A block of wood weighs less than a block of lead of the same size for a similar reason, namely, that the particles of matter in the wood are not so closely packed as the particles of matter in the lead. In other words, lead is denser than wood, and wood is denser than cork or cotton batting.

It is important to have a measure of density—of the closeness with which matter is packed—to know in short the "specific density" of different substances. It was Archimedes who first put us in the way to find this (*see* Archimedes). Having noticed no doubt that any object suspended in water seems lighter than in air, Archimedes tried weighing various substances in air and water. Thus he discovered one of the most important principles of hydrostatics. This, the "principle of Archimedes," is that a body wholly immersed in any fluid is buoyed up by a force equal to the weight of the fluid it displaces.

If a substance is weighed first in air, then in water, and the weight in air is divided by the loss of weight in water, the result, which expresses the density of that substance as compared with water, is called the "specific gravity" of that substance. The specific gravity of gold is 19.3; that of silver, 10.5. That is, gold is 19.3 times as heavy as water, silver only 10.5 times. So, if Archimedes found the specific gravity of the king's crown to be less than 19.3, he was confirmed in his conclusion that the goldsmith had not made it of pure gold alone.

GALILEO'S EPOCHAL EXPERIMENT

Will a heavy object fall faster than a light one? There are still probably a good many people who would answer confidently, "Of course a heavy object will fall faster." That's what the world thought until Galileo went up in the Leaning Tower at Pisa, Italy, and made his famous experiments. He chose this tower, not only because it was high, but because he could drop things off without hitting the sides of the building on the way down. Here we see him just about to let fall two iron balls, one much bigger than the other. They both hit the ground at *exactly the same time.*

Another important division of this subject has to do with the "center of gravity" of solids. The center of gravity of any object is the center of its mass or weight. In a symmetrically shaped object of the same density throughout, the center of gravity will be at the geometrical center. If the center of gravity is "supported"—if a line dropped from the center of gravity passes through the base of the object—that object is in equilibrium and will not fall. This is the case with the Leaning Tower of Pisa, from which Galileo made his experiments. The tower stands safely, but if you want to know what would happen if it were to be built higher, try building a leaning tower of blocks. It stands so long as the center of gravity is over the base; but when the center of gravity is carried up so that it is no longer above the base, over goes your tower.

The tight-rope performer has learned by long experience to keep the center of gravity of his body directly over his base of support, the wire. Of course the narrower the base the more difficult it is to keep the center of gravity exactly over it. This is why it is hard to balance a pencil or an umbrella, and also why tight-rope walking is difficult and dangerous. It is easier for a baby to creep than to walk, because when he is on all fours his center of gravity is carried over a broader base than when he stands on his feet.

From the beginning of life to the end we are playing a game with the force of gravity. The baby trying to carry a spoonful of bread and milk to his mouth without spilling it, or to balance himself on his two little legs, is just learning to play the game. So are the architect and the engineer, each using all his knowledge of mathematics and physics in the construction of buildings, bridges, and railroads. So most emphatically is the aviator, whether he flies safely and sanely or performs daredevil "stunts." A curious game it is, with the force of gravity as both opponent and partner.

What has been explained here is but the beginning of a glimpse into the known facts of this great law; and don't imagine that everything about it is known even yet. From one point of view it seems very simple—the most sweeping and unconditional generalization yet made in regard to the workings of the universe. But neither has Newton nor anyone else yet shown the nature of the force which operates through the law of gravitation. *How* the apple falls to the ground we know—it is in accordance with an unvarying universal law; but we don't yet know *why* the apple falls.

GREAT BRITAIN. A strip of water only 21 miles wide separates the French city of Calais from the "tight little island" of Great Britain. But the rough waters of the English Channel, the North Sea, Irish Sea, and St. George's Channel, which surround it, shut the people of Great Britain away from their enemies in the days of their weakness, and when they grew strong the sea furnished them broad highways by which they might trade with other nations. The people of Great Britain have put their trust in its waters, and their merchant marine and navy have made their land the "mistress of the seas."

This little island—about the size of Minnesota—which stands at the western door of Europe, has been favored by nature in many ways. It has an excellent climate, neither very cold in winter nor very hot in summer, and with an abundance of rainfall. Its broad deep rivers—the Thames, Humber, Severn, Mersey, and Clyde—admit ships a considerable distance into the land. On its fertile soil can be grown most crops of the temperate zone. And in its mountainous regions of the north and west are to be found unsurpassed deposits of coal and much iron, without which Great Britain could never be the industrial nation it is today. In her 88,210 square miles there is almost every kind of land, from the lowlands of southeastern England to the rugged highlands of Scotland and Wales.

Before 1707 Great Britain was merely a geographical name. The chief country in the island was England, to which Wales had been added by conquest in 1282; and to the north was the separate kingdom of Scotland. Since James VI of Scotland had ascended the English throne in 1603 as James I of England, the two countries had always had the same ruler. But it has only been since the Act of Union of 1707 that the two countries have been united under the name of Great Britain. In 1801 another Act of Union brought Ireland, which had long been a dependency of England, under the same Parliament with Great Britain, and the official name of the country was changed to the "United Kingdom of Great Britain and Ireland." In this same government are included also the other British Isles—the Hebrides, Orkneys, Shetlands, the Isle of Wight, and the Isle of Man—and the Channel Islands (Jersey, Guernsey, Alderney, and Sark).

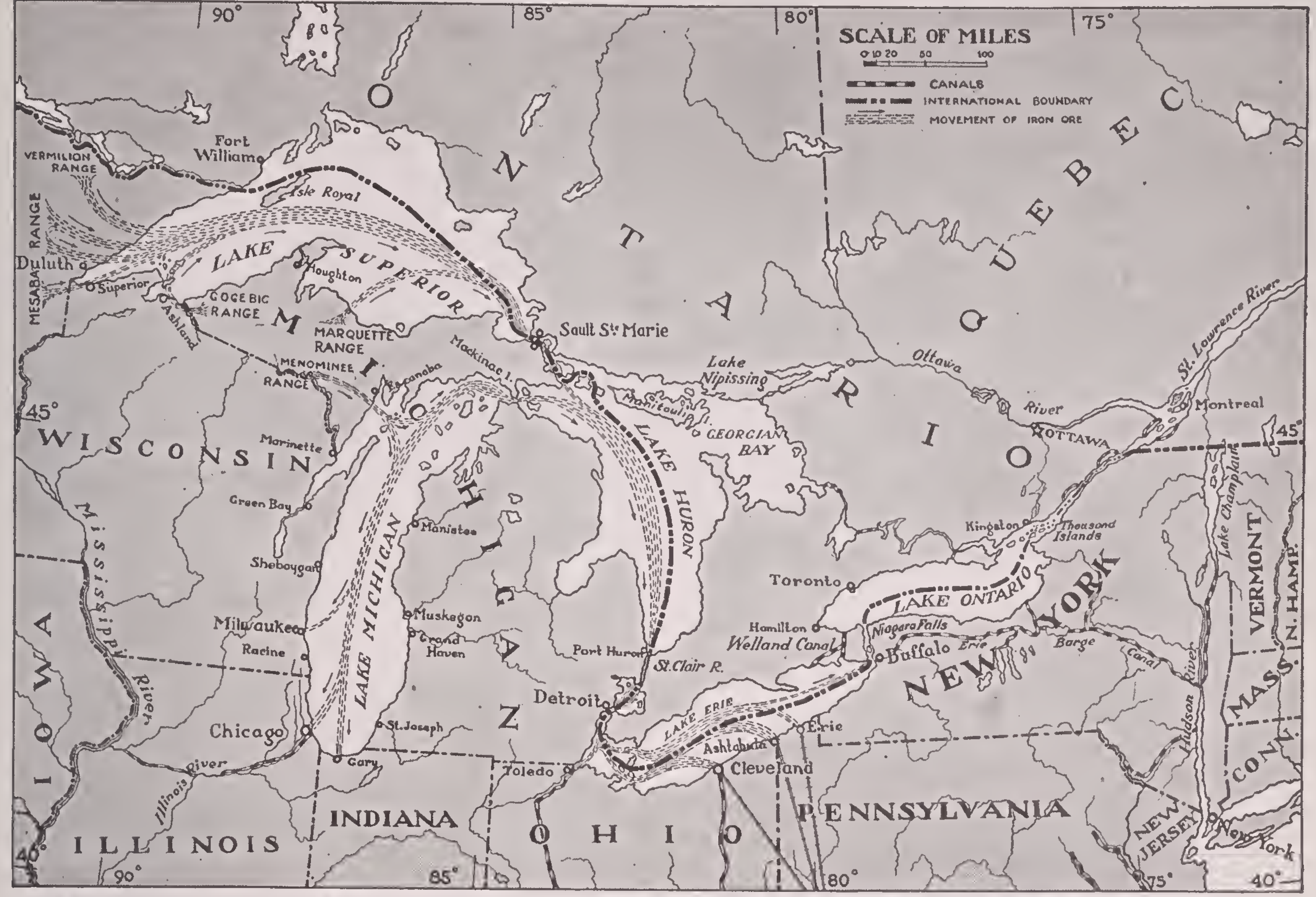
The union of Scotland, Ireland, and England is shown by the flag of Great Britain. Before the first Act of Union the flag of England was white, with a large upright red cross; that of Scotland was blue, with a diagonal white cross; and a red diagonal cross was one of the emblems of Ireland. In the modern "Union Jack," all three of the crosses are united in a single emblem. (*See also* British Empire; England; Ireland; Scotland; Wales.)

NORTH AMERICA'S GREAT UNSALTED SEAS

ITALY and Spain and Greece have their Mediterranean, the most romantic of inland seas. But the United States and Canada have their own Mediterranean—the Great Lakes, whose sparkling waters and blue skies and great cities present scenes rivaling those of the Old World Mediterranean for charm and beauty. Two centuries ago their waters were furrowed only by the occasional canoe of the Indian or the fur-trader; today they float a merchant marine of thousands of huge freighters, carrying a commerce richer than that of many a powerful nation.

GREAT LAKES. In all the world there is no other system of inland waterways that compares with the large lakes—Superior, Michigan, Huron, Erie, and Ontario—that lie along the boundary between the United States and Canada. These inland seas are nearly as large as all the other fresh-water lakes of the globe put together, nearly 100,000 square miles, and the thousand or more streams that feed them drain an area of about 288,000,000 square miles. To coast along their shores in the United States alone you would travel more than 4,000 miles. So vast are they that their storms are like ocean storms, and they have an oceanic effect upon the climate, absorbing heat in summer and giving it out in winter, thus tempering the extremes of climate along their shores. As a result, parts of Michigan, and the southeast shores of Lakes Erie and Ontario, where the effect of the lakes is most felt because of the prevailing winds, are important fruit districts.

THE TRAIL OF COMMERCE ON AMERICA'S INLAND SEAS



Here are the five lakes which are among the busiest bodies of water in the world. The heavy broken line shows how the boundary between the United States and Canada divides them. The light lines show the lanes followed by the iron ore traffic. The ore is dug in the great ranges of Minnesota, upper Michigan, and Wisconsin, and is carried by rail to ports on Lakes Superior and Michigan. From these ports it is transferred by boat to the mills on or near Lake Michigan and Erie. This traffic alone maintains a string of steamers scarcely out of sight of each other's smoke all along these lanes, and when you remember that iron ore is only one of many commodities carried on the Lakes, you can understand how important they are in America's economic life. Note the canal routes connecting the Lakes with the important rivers to the south and east.

Varying in depth from 1,000 feet in Lake Superior to 210 feet in Lake Erie, the lakes are open to navigation by large vessels from end to end. You may take a steamer the size of an ocean liner at Buffalo and sail away for a thousand miles to Duluth or Chicago, nearly half the length of the Mediterranean. On smaller craft you may voyage farther still. Barges and pleasure launches go down the Chicago drainage canal to the Illinois River, the Mississippi, and the Gulf of Mexico; while vessels of 14-feet draught can pass around Niagara Falls by the Welland Canal, and down Lake Ontario and the St. Lawrence River to the Gulf of St. Lawrence and the ocean. Projects have long been on foot to deepen both these "lakes to ocean" routes, so that ocean steamers of 30-feet draught may ply between lake ports and foreign cities, thus saving the expense of trans-shipping cargoes from lake to ocean vessels.

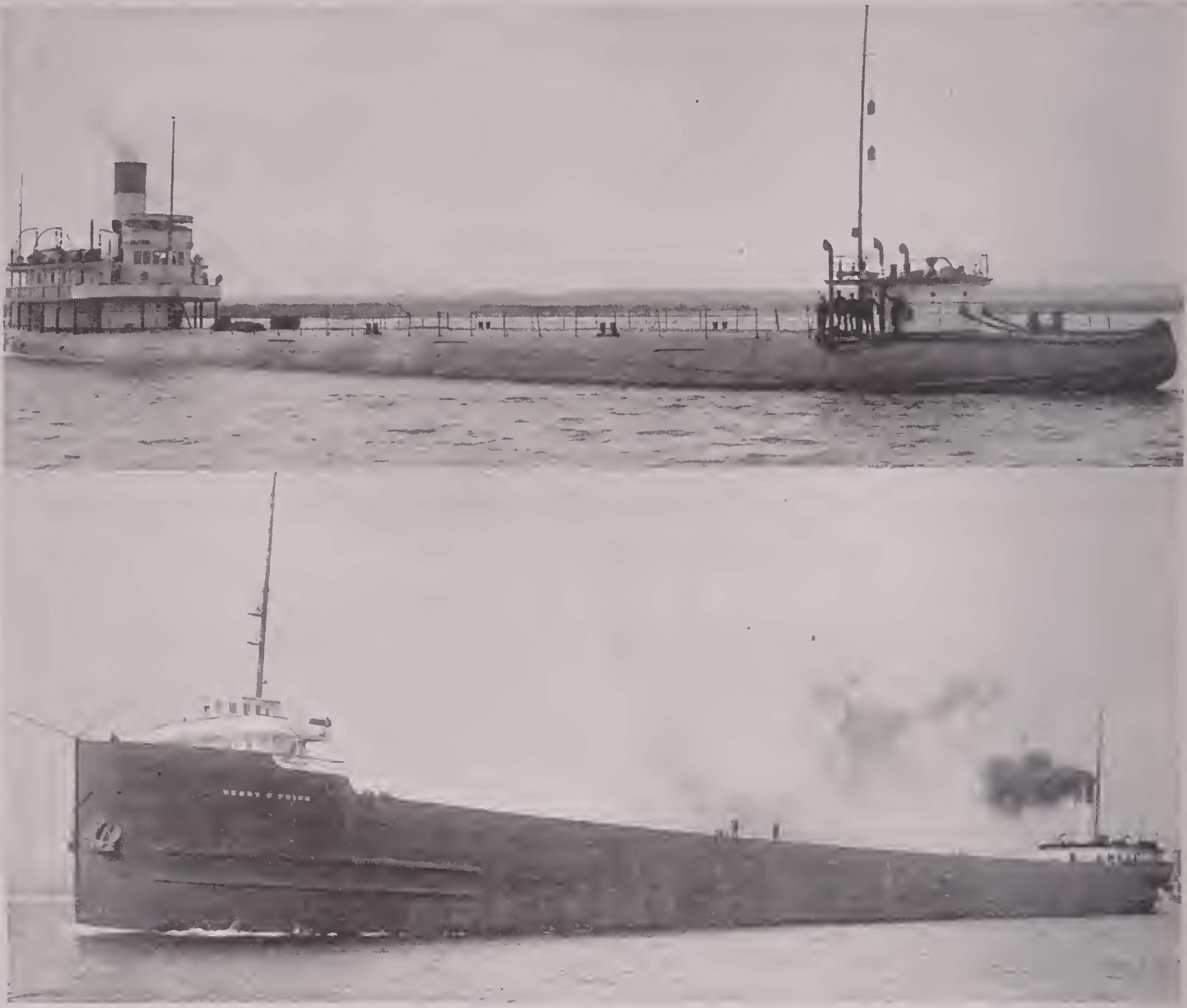
DIMENSIONS OF THE GREAT LAKES

Lake Superior.—Length, 400 miles; greatest width, 167 miles; area, 31,200 square miles; greatest depth, 1,008 feet.
Lake Huron.—Length, 250 miles; average width, 150 miles; area, with Georgian Bay, 23,200 square miles; greatest depth, 702 feet.
Lake Michigan.—Length, 316 miles; average width, 75 miles; area, 22,400 square miles; greatest depth, 868 feet.
Lake Erie.—Length, 245 miles; greatest width, 57 miles; area, 10,000 square miles; greatest depth, 210 feet.
Lake Ontario.—Length, 190 miles; greatest width, 53 miles; area, 7,260 square miles; greatest depth, 738 feet.

From December or January until April the lakes are in large part ice-bound, and vessels lie idle in the river harbors of Chicago, Cleveland, Buffalo, and other ports. Terrific storms mark the end of the navigation season, and the freighter that ventures out for one last trip is sometimes never heard from again, or perhaps hobbles into port coated with ice, and with hundreds of its rivets shaken out by the buffeting of giant waves. Whitefish Bay, at the east end of Lake Superior, is known as "the Graveyard of Ships," from the many wrecks there.

The importance of these great waterways to the prosperity of the United States and Canada cannot be overestimated. The vast region tributary to them is the richest part of the continent in farm, forest, and mine products. Without the cheap transportation which the lakes afford, the development of the Northwest would have been far slower. If you have

STRANGE WATER GIANTS OF THE GREAT LAKES



The peculiarly violent choppy storms that sweep over the Great Lakes make special types of freight vessels desirable. At the top we see the famous old "whale-back" type, with a hull shaped like a submarine. This allows the waves to break freely over the ship, while the ship yields and rolls, and so avoids the strain upon its framework. The lower vessel, however, has proved even more efficient than the "whale-back." The entire middle of the ship is one great open cargo space, and the main ribs of the hull all run lengthwise, so that the craft can twist and give under the buffeting of the waves.

never visited Chicago, Detroit, Duluth, or Buffalo, you would find it hard to realize the immensity of the Great Lakes commerce. More vessels enter and clear at Chicago than at any other port of the United States, excepting only New York. A greater tonnage passes through the Detroit River in the seven or eight months of navigation than that which enters and clears at all the Atlantic and Pacific ports in a year, and almost as much passes through the "Soo." About four-fifths of all the iron ore used in the United States is transported by water from the Lake Superior region, and without this advantage the immense iron and steel industry of the United States could never have prospered as it has done.

The fisheries too are an important resource, for they are the greatest lake fisheries in the world. The United States waters alone produce more than 100,000,000 pounds of food fish every year—whitefish, lake herring (cisco), lake trout, pike, and perch. Lake Michigan and Lake Erie contribute about three-fourths of the entire catch.

From Chicago you may take almost as many different lake voyages as there are days in the summer passenger season. You may make a day's trip across to one of the summer resorts on the east shore of Lake Michigan—Benton Harbor, Holland, Muskegon, South Haven, Ottawa Beach, or St. Joseph—whose gently sloping sandy beaches are a delightful place to swim; or you may spend several days coasting the western shore of the lake, stopping at Racine, Milwaukee, Sheboygan, and the Green Bay ports. At the head of the lake you will come to Mackinac Island, lying in the Straits of Mackinac, between lakes Michigan and Huron. This popular summer resort, with its clear air and delightful pine woods, its old fort built by the French in 1712, and its French

ALONG THE SANDY SHORES OF LAKE MICHIGAN

Nothing could be more typical of shore scenery along the Great Lakes than this wooded sandy bluff. Sometimes with a smooth sandy beach in front and sometimes dropping off sheer into the water, this type of shoreline runs around much of Lake Michigan. The railroad train is carrying "week-enders" southward from the summer resorts in northern Michigan on an over-night run to their work in Chicago.

and Indian traditions from fur-trading days, was at one time one of the important military posts of North America.

From Mackinac, if you are bound for Lake Superior, your steamer will go eastward for 60 miles to St. Mary's River, wind for another 50 miles through its narrow channels, and then climb the great steps of either the Canadian or American locks at Sault Ste. Marie to the highest as well as the largest of the Great Lakes. There has been a canal with locks on the American side of the "Soo" since 1855, to pass around the rushing rapids (*sault*) where the St. Mary's River issues from Lake Superior. Today there are two great series of locks. One of the locks in the American canal (completed in 1919) is 350 feet longer than the locks of the Panama Canal; and the Canadian locks also are huge (*see* Sault Sainte Marie).

Here you will see such a scene of activity as few of the world's great waterways can show. Great barges and passenger steamers with their prows and sterns a city block apart go through at the rate of one every 12 minutes. Many of the west-bound barges carry coal from Ohio and Pennsylvania for the northwest; while most of those east-bound are heavily loaded with immense cargoes—10,000 to 12,000 tons—of copper ores from the "copper country," or of iron ores from the upper peninsula of Michigan and the ranges about Duluth. Others carry hundreds of thousands of bushels of wheat grown on the farms of the American or Canadian Northwest, a single boat sometimes bearing under its hatches the grain from 30,000 acres. Now and then you see a boat loaded from stem to stern with lumber, which not only fills its hold but is piled high on its decks. Nearly a thousand vessels are engaged in the "coal for iron ore" exchange alone, and some seasons over 100 million tons of freight go through the Sault Ste. Marie canals, while the shipping tonnage totals three times as much as goes through the Suez Canal in normal years.

When your steamer has climbed the locks at Sault Ste. Marie, there is still a 30 hours' journey before you on Lake Superior. A hundred miles farther on, if the weather is good, your ship will go near shore so that you may see the Pictured Rocks. This ten miles of cliff, banded with blotches of red and yellow and carved into pillars and caverns, shows where the lake level used to be a few thousand years ago. The next day the ship stops at Houghton and Hancock on the Keeweenaw Peninsula, where one-seventh of the world's supply of copper is mined every year, and from which freighters have been known to carry a cargo worth a million and a quarter dollars. Instead of rounding the peninsula the ship goes through a canal between the twin cities, and in another half-day lands you at Duluth (Minn.), the western head of lake navigation. Ten miles south lies Superior (Wis.), a rival to Duluth for the lake traffic. At all these ports you will again meet the freighters unloading coal in enormous piles a block or two long, and then taking on cargoes of iron ore at giant piers which stretch far out into the harbor and tower into the air like grain elevators. Through a score or more of chutes the ore pours into the opened hatches with such speed that a ship can take on a 12,000-ton cargo in two hours. About 150 miles northeast of Duluth you would find similar scenes being enacted at Fort William and Port Arthur, the Lake Superior twin ports of Canada.

But perhaps you turned eastward at Mackinac Island or the "Soo" instead of westward. A small steamer will take you by the picturesque route back of Grand Manitoulin Island past Little Current and Kilarney to Parry Sound, on Georgian Bay; whence a still smaller steamer will carry you in and out among the amazing variety of the Thirty Thousand Islands

THOUSANDS SEEK THE BEACHES IN SUMMER

Here is the beach at Macatawa Park, one of the many summer resorts which dot the eastern shore of Lake Michigan. Practically all of these resorts are of the same general pattern. A placid river comes wandering westward from the interior of Michigan and upon encountering the shoreline bluffs broadens out into a small lake. A narrow channel, improved by jetties such as you see in the background, connects the inland lake with the larger body of water. Thus these resorts combine the attractions of a small lake with its boating, the large lake with its surf and cool breezes, the wooded hills of the shoreline, and the open farming country inland.

which dot the bay and form a paradise for fishermen and summer cottagers. Or you may have continued from Mackinac on to Buffalo. For 250 miles you travel over Lake Huron to Port Huron, at the entrance to the St. Clair River. For 30 miles you steam between the banks of rich and beautiful country, tapering off into "the St. Clair flats," where lies a summer settlement sometimes called "Little Venice," for under the *portes cochères* of the houses you will find water instead of driveways. A canal a mile long then brings you out into Lake St. Clair, and 18 miles farther finds you at Detroit. Another 20 miles along the beautiful Detroit River and you are on Lake Erie, 8 feet lower than you were on Lake Huron, although you have not had to climb down any locks to overcome this difference in level. A few hours more, and you reach Buffalo, where you see vast cargoes of grain unloaded from big lake barges and transferred to canal boats or freight cars for shipment to the large eastern cities.

Steamers of 14-feet draught may go farther still—through the Welland Canal around Niagara Falls, and so on down Lake Ontario and the St. Lawrence River to the Gulf. This is the way many lake freighters were taken out to the ocean during the World War of 1914–18, though the locks of the old Welland Canal were so small that some of the ships had to be sawed in two to make the trip.

The history of the Great Lakes dates back nearly 300 years. The French discovered Lake Ontario in 1611, and four years later Champlain discovered Lake Huron, following the famous Algonquin route up the Ottawa River, portaging across to Lake Nipissing, and thence down the French River to Georgian Bay. Lake Erie was the last (1669) to be reached by white men, owing to the hostility of the Iroquois tribes. The first sailing vessel on the lakes was La Salle's *Le Griffon*, of 40 or 50 tons, launched on the Niagara River in 1679. The first steamboat appeared on Lake Ontario in 1817. The opening of the Erie Canal in 1825 started immigration westward by canal and lake, and by 1833 there were 11 steamboats on the lakes making a trip or two each season from Buffalo to Chicago. Today the great passenger steamers are the safest and most comfortable means of travel during the navigation season between many points on the lakes. Government charts of the lakes showing lighthouses, lightships, buoys, and life-saving stations now facilitate navigation, which calls for as high a degree of skill as navigation upon the high seas, although it presents somewhat different problems.

In order to give big steamers an opportunity to load as deeply as possible, commissions of American and Canadian engineers keep constant watch over the water levels in each of the lakes. This is necessary because the channel at Niagara and the Drainage Canal at Chicago draw off enormous quantities of water, and if the level of the lakes should be lowered by even a foot below the standard depth, the heavily loaded cargo steamers could not get over critical points in various channels with safety.

Several important naval engagements were fought on the Great Lakes during the War of 1812, notably the Battle of Lake Erie (*see* Perry, Oliver Hazard). Then in 1817, at the instance of John Quincy Adams, then Secretary of State of the United States, the Great Lakes were neutralized by agreement between Great Britain and the United States. For more than a century no naval force has been maintained on their waters, and the forts which had been erected to protect strategic points have been left to molder into picturesque ruins. (*See* Canals; *also* articles on the various lakes.)

GREAT SALT LAKE. There should be no more popular resort for bathers than Great Salt Lake, the mysterious mitten-shaped sheet of water in the midst of Utah's desert plain. It is impossible for anyone to drown in it unless he deliberately puts his head under the water or ties a weight to his feet, because the water is one of the most concentrated brines in the world. The bather may sit in it, or float upon his back with his arms crossed under his head and enjoy a pipe with as much comfort as on the shore. But he must wash the water off after he bathes or he will be encrusted in salt.

This "Dead Sea of the New World" bears a striking resemblance to the famous one in Palestine. It has a Jordan River, too, but although the lake has been receiving its waters for centuries, there is no visible outlet. Because of its extreme saltiness it contains almost no plant or animal life, and although very shallow, is really a sea in its dimensions, having about 1,700 square miles. Its area, however, is variable, because during some periods it receives more water than it loses by evaporation. It is only a remnant of a far greater lake, called by geologists Lake Bonneville, which ages past covered an area of nearly 10,000 square miles with a depth of 1,100 feet.

One of the most noteworthy engineering achievements ever attempted in trestle and fill-in work is the cut-off through the north arm of the lake, between Ogden and Lucin. This shortening railroad was built at enormous cost to avoid the steep grades encountered in the old line around the north shore of the lake.

The Mormons early utilized the salt of the lake, and the salt works and refineries on its shores obtain crude salt simply by pumping out the water and evaporating it in shallow beds on the shore. Geologists place the total of the available salt deposits at 400,000,000 tons.

MOTHER GREBE AND HER WATER BABY

The little Grebe has just been hatched out of his egg in the floating nest and has promptly tumbled into the water for a swim. Mother Grebe is probably teaching him a few strokes. By and by those other eggs will hatch and the mother will take them all riding on her back.

GREBES (*grēbz*). The young grebe is a true "water baby." When he has pecked his way out of the egg, he finds himself on a sort of raft-nest floating on the water. For a few minutes he looks over the edge of the raft, observers tell us, and then—splash! Over he goes, swimming off with all the skill of an old hand. But young birds are too weak for much violent exercise, so the grebe parents have a most interesting way of taking the little ones riding on their backs. Sometimes you can see an old grebe with two or three chicks nestling just under the wing-coverts, with only their heads exposed. At the slightest sound, up go the parent's feathers, completely hiding the chicks, and sometimes if alarmed the old birds will dive, keeping the little brood in place under the wings.

On land, the grebes are comical sights. Their legs are placed so far back that when they walk they carry their bodies upright, like penguins, waddling along with great awkwardness. Sometimes they wriggle along on their bellies, like seals. Their feet are not webbed in the same way as those of most diving birds, but have a separate membrane for each toe, united only at the base. Their shanks are flattened to bladelike thinness, and when they fly on their short powerful wings the feet trail behind like a rudder. But the water is their native element, rather than the air, and they swim and dive with wonderful skill, being able to swim long distances under water. Their smooth hairlike plumage is quite waterproof, and the beautiful silver-white breast feathers are so much coveted for millinery and for muffs and dress trimmings that thousands of these interesting birds are slaughtered every year.

There are about 25 species of grebes, spread over most of the world. They form the family *Colymbidae* of the order of diving birds (*Pygopodes*), which also includes the loons, auks, and puffins. The best known of the American grebes is the pied-billed grebe (*Podilymbus podiceps*), also known as the hell-diver, the water-witch, or the American dabchick. It is about 13 inches long, with a short thick bill; plumage brownish-black above and light brown and white beneath. (For illustration in colors, *see* Birds).

A GOLDEN DAY IN GOLDEN GREECE

This Greek mother and her children are walking in the streets of ancient Athens. In the background are the famous buildings of the Acropolis bathed in sunshine. The distinguished French artist André Castaigne has here successfully caught the spirit of those glorious days of old, when life was more serene and leisurely than it is in these busy modern times. Beauty to the Greeks of old was one of the most important things in life, and no other people has ever realized the ideal of beauty so completely in their everyday surroundings.

The LAND where EUROPEAN CIVILIZATION was BORN

These ruined walls and columns on the Acropolis at Athens, scarred by the ravages of the centuries, mark the center of what was once the Intellectual Empire of the World. Such fragments of the architecture of the Greeks, the immortal forms they carved from the marble of their mountains, their superb achievements in literature, and the noble system of government they created, have been among the most vital sources and inspirations of the Architecture, the Art, the Literature, and the Free Institutions we enjoy today.

Area.—European Greece, 57,400 square miles, of which the peninsula of Greece (roughly corresponding to the ancient Hellas) occupies about 25,000 square miles; claims in Asia Minor (Smyrna, etc.), about 12,000 square miles. Population, about 6,300,000.

Physical Features.—Deeply indented mainland coast, with many small islands, especially Cyclades and Sporades groups in Aegean Sea. Corinthian and Saronic gulfs nearly separate northern and central Greece from southern Greece (Peloponnesus or Morea). Four-fifths of the surface covered by complicated mountain systems, inclosing many small valleys; chief ranges, Cambunian and Pindus; highest point (in Thessaly), Mount Olympus (9,754 feet). No navigable rivers.

Products.—Wheat, barley, rye, and other cereals; currants, grapes, and wine; olives and olive oil, figs, oranges, lemons, etc.; tobacco, silk; sheep and goats; iron ores, lead, zinc, lignite; textile and leather manufactures.

Chief Cities.—Athens (capital) and its port Piraeus (combined population, more than 300,000), Saloniki (250,000), Patras (40,000).

GREECE. The traveler in Greece often finds himself wondering how so small a country could fill so large a place in history. Even including the territories won as a result of the Balkan War of 1913 and the World War, it is smaller than any one of 20 states of the American Union. From Mount Olympus, which marked the northern limit of ancient Greece, you can see over nearly all northern and central Greece; and if you take your stand on Mount Parnassus (modern Liakoura), which is near the center of Greece, you can see nearly all the mainland spread out below you like a map. Travel less than a hundred miles south, and from the mountains of Sparta you can see Crete, the southernmost of the 500 islands which make up an important part of Greece.

But though this little country is only a small patch on the map of the world, it was the cradle of European civilization and has wielded a greater influence on the course of history than any other single nation. Why? The answer is largely a matter of geography. It was their land and sea, their mountains, bays, and islands, that helped to make the ancient Greeks what they were and determined the course of their history.

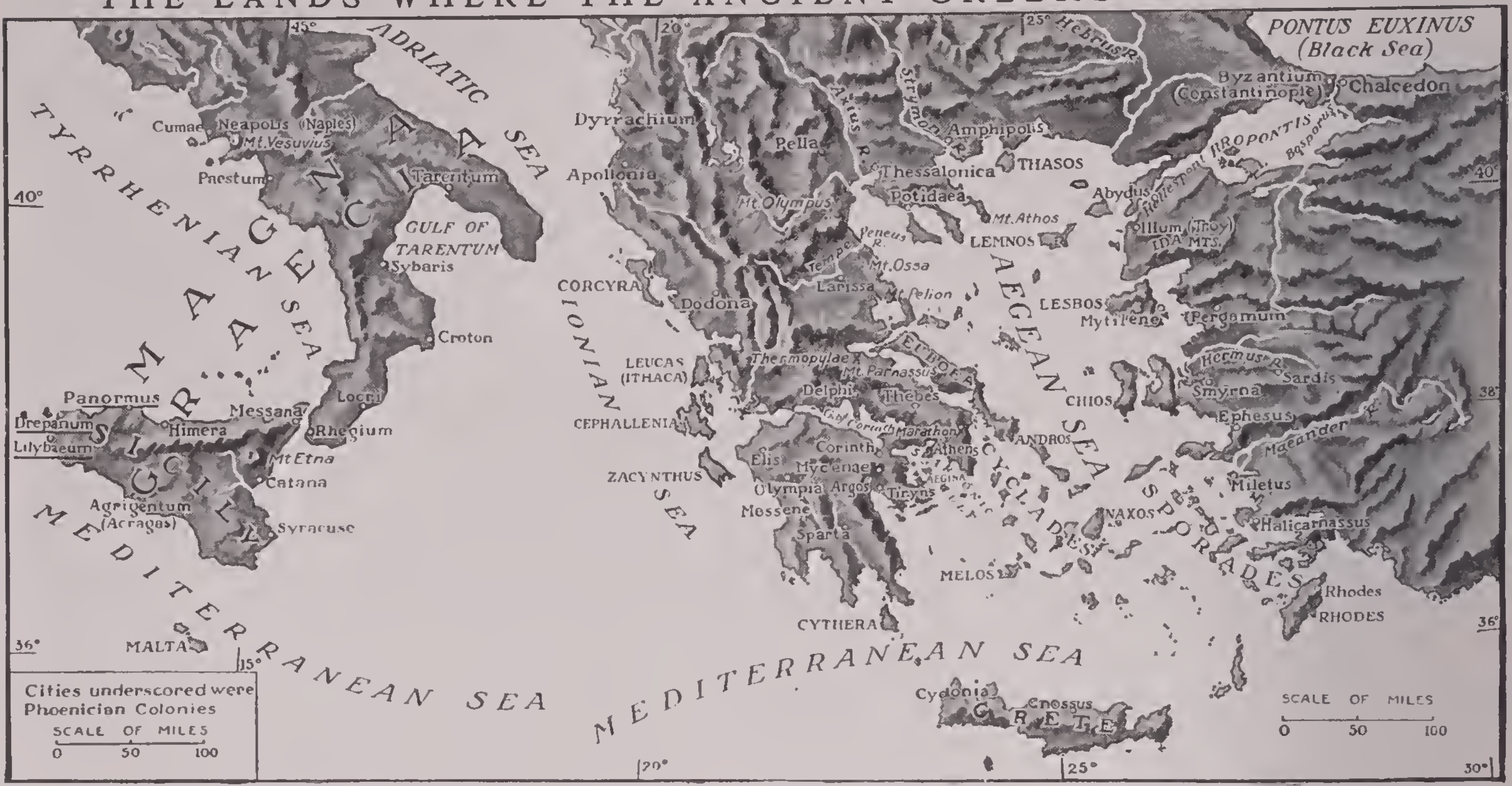
First you must notice that Greece is the easternmost of the three peninsulas that Europe throws off into the Mediterranean toward Africa and Asia, where man first emerged from barbarism to civilization. Between the mainland of Greece and the coast of Asia Minor the sea is thick-strewn with hundreds of islands—the tops of submerged mountains that once formed a continuous land-bridge. These islands are like a series of stepping stones, inviting to travel, and so the inhabitants of Greece were the first of European peoples to be brought into contact with the civilizations of Asia (*see* Aegean Civilization).

Look more closely at the map, and you will observe that the sea fairly riddles the land, forming so many gulfs and capes that no part of Greece outside Thessaly in the north is more than 50 miles from the coast. So many are the indentations that the coast-line of the Greek peninsula is longer than that of Spain and Portugal, although those countries are six times its size. The greatest of these inlets is the Gulf of Corinth, which all but cleaves Greece in two. The only connection is the narrow Isthmus of Corinth (which is now cut by a canal), so that southern Greece, or Morea as it is now called, was known to the ancient Greeks as Peloponnesus (Pelop's Island).

Thus the sea everywhere opened its beckoning arms to the Greeks and invited them to the adventurous and progressive life of the mariner and trader. Their natural keenness and alertness was intensified by this constant intercourse with other peoples, their imagination and thought were stirred, forming fruitful soil in which the seeds of Egyptian and Asiatic civilization might bear new and finer flower.

This urge to the sea was reinforced by the character of the Greek land itself. Four-fifths of its surface is wrinkled by a complex system of mountain ranges which chop the surface up into a number of tiny plains. Practically all the arable land is contained in these little isolated valley-patches. One-third of all

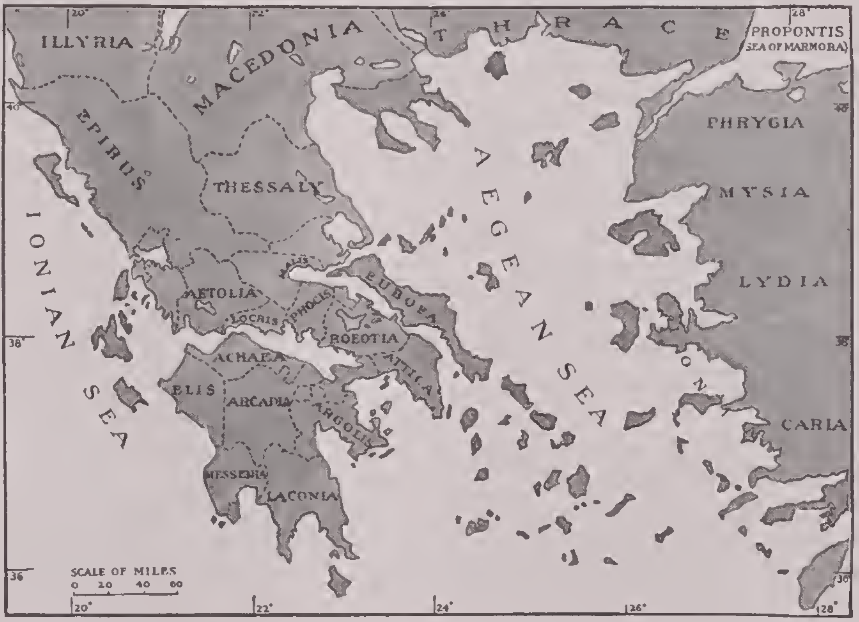
THE LANDS WHERE THE ANCIENT GREEKS HELD SWAY



We must remember that in olden days the name "Greece" did not mean the Greek peninsula alone. It included also the "sprinkled isles" of the Aegean Sea, the western slopes of Asia Minor, Crete, Sicily, and southern Italy. Indeed, the last two were known as "Magna Graecia" (Greater Greece). In all these outlying lands were Greek colonies—mostly of the city-state type, patterned after Athens, Sparta, Thebes, and the other cities of the homeland. Although they were for the most part independent communities, often at war with one another, they were spiritually united by the great bond of Greek civilization and culture.

the surface today is waste land—rock and sand and gravel—with no soil that will grow even grasses. The remainder is divided between the forests, from which the Greeks obtained the charcoal that formed their only fuel, and the pasture land, most of it bristling with prickly asphodel and other dry scrub, too juiceless for the taste of any animals but sheep and goats. A few cows and pigs were raised, but sheep and goats supplied most of the meat that the Greeks ate, as well as wool and cheese. The "harvests of the sea"—chiefly tunny, sardines, and anchovies—largely took the place of meat in the Greek diet. On the scanty areas of tillable land were grown the "Mediterranean triad"—grains, wine-grapes, and the olive—which formed their staple foods. Moreover these lands were far from being remarkable for fertility, and much hard labor was necessary to grow wheat and barley successfully. The few rivers are small and rapid; none are navigable and many are dry in summer. Thus, unlike the Italians, with their fertile soil, the Greeks were fairly pushed off the land to make good its deficiencies by trade and by settling the surrounding islands and coasts. Their constant struggle with a niggardly land also tended to make the Greeks a vigorous and energetic people. Greece was, as Homer puts it, "rough, but a mother of men." This is no less true of the bracing winter climate. The summers are clear and almost rainless; the winters sharp with heavy rains and snows. No barriers intervene to break the force of the winds which sweep across from the Asiatic continent, and this helped make the Greeks a tough and hardy race.

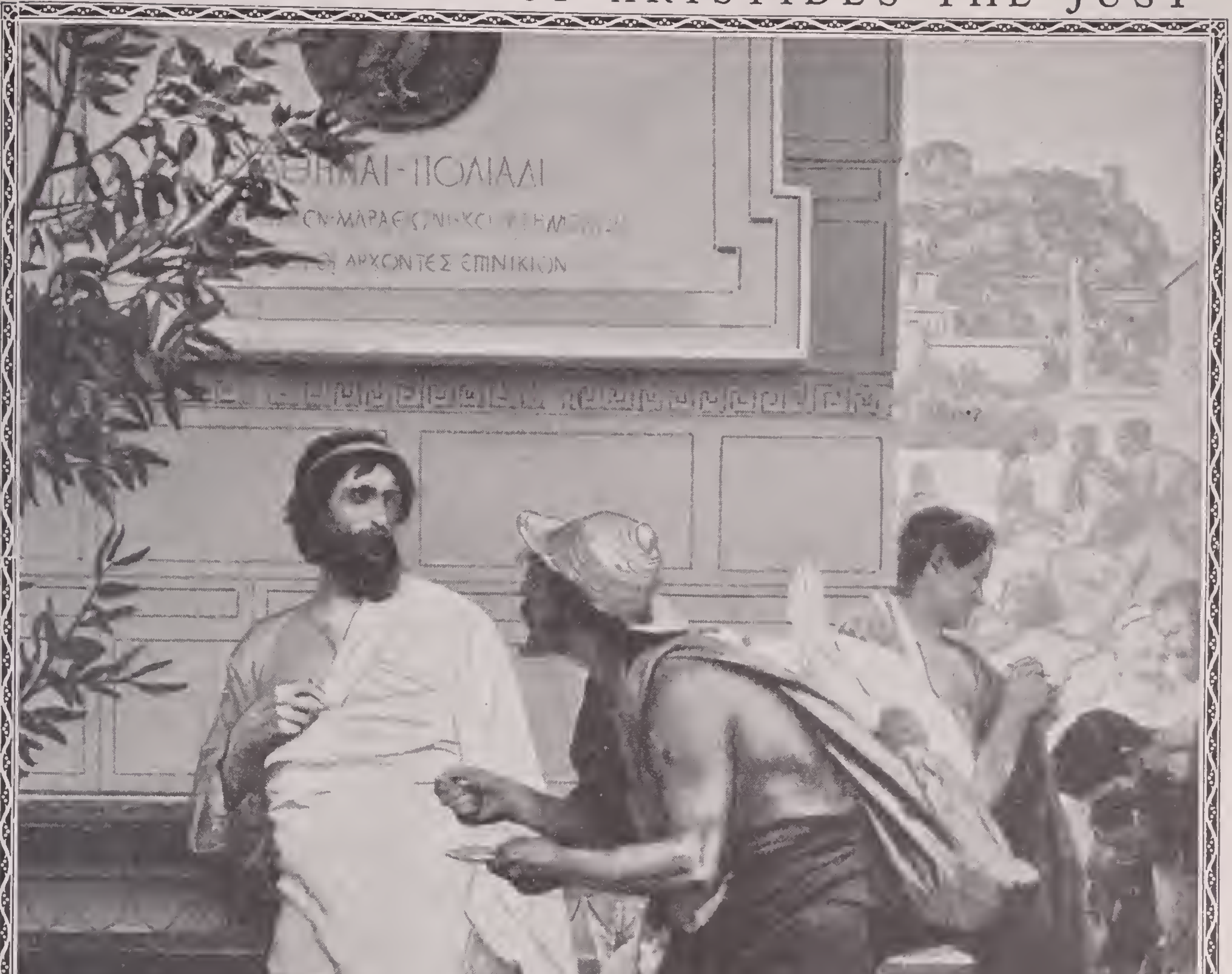
THE DIVIDED STATES OF GREECE



One of the reasons for the downfall of Greece before the conquering sword of Rome was the lack of political unity between the many small states into which the peninsula was divided. These political divisions were caused by the numerous inlets from the sea and the many mountain ranges, shown in the map at the top of the page, which cut up the peninsula into a great number of more or less isolated valleys and plains.

The story of the coming of the Greeks into this land takes us back to about 1500 B.C., when wave after wave of barbarian invaders swept over the towns and cities of a great civilization, destroying it and then gradually building up a new civilization upon its ruins. About the splendid and far-flung

THE OSTRACISM OF ARISTIDES THE JUST



In democratic Athens unpopular statesmen were sometimes banished for a ten-year period. This was done by the process of "ostracism," named after the Greek word for "potsherd," because it was upon bits of broken pottery—the "scrap paper" of antiquity—that the voters wrote the name of the man they wanted banished. How unfairly the people sometimes used their power of ostracism is shown by the story told about the banishment of Aristides, the famous rival of Themistocles, which we see pictured above. An ignorant countryman has come to the voting place, and has asked a bystander to write the name of Aristides on his potsherd. That bystander is Aristides himself. "Has Aristides done you any injury?" he asks the countryman. "No," the other replies, "but I am tired of hearing him called 'the Just.'" So Aristides with a sad smile writes his own name.

culture which the rude Greek tribesmen found on their irruption into the Aegean basin—the Aegean civilization with its gold and bronze and pottery and paintings and its great palaces at Cnossus in Crete and at Mycenae and Tiryns on the mainland—you may read elsewhere (*see* Aegean Civilization). The Greeks who swept down from the north and overwhelmed these cities were simple nomadic herdsmen—a branch of the Indo-European race that had for centuries been drifting to the east and west from their home in the grass-lands east and northeast of the Caspian Sea (*see* Philology). The first wave of invaders were the fair-haired Acheans of whom we read in Homer. The Dorians, who composed the second wave, came perhaps three or four centuries later, subjugating in their turn their Achean kinsmen. Other tribes, the Aeolians and the Ionians, found homes chiefly on the islands and coasts of Asia Minor.

Life of the Early Wanderers

Something of the culture of the Aegean civilization these Greek—or, as the Greeks called themselves, Hellenic—invaders must have absorbed when they settled down and intermarried with the people they conquered. But, being still in the nomadic stage themselves, they were not fitted to come into the whole heritage of a city civilization. So of the earliest stages of the Greek settlement we know little, for these invaders were neither builders nor writers. But we may imagine them moving southward from their pasture lands along the Danube, driving their herds before them, bringing their families and primitive goods in rough ox-carts, stopping in one place just long enough to plant and harvest one crop. These families settle down in the pasture lands of the peninsula, gradually take up farming, and little by little form communities ruled by kings and elders.

At this point we can begin to picture them. For the background of the 'Iliad' and the 'Odyssey' is the background of the Age of the Kings (*see* Homer). We see the Acheans living very simply, a race devoted to warfare. Their weapons and their songs are the only splendid things they have, except for the gorgeous robes and the beautiful jewelry and metal work they bought from Phoenician traders (*see* Phoenicians). The palace of Odysseus is built of wood, a hall about a court. In this hall they cook and eat. Sometimes it gets very smoky, for there are no chimneys. And the bed of Odysseus is no work of the cabinet-maker's art, but a very rude affair wrought by Odysseus himself out of a living olive tree.

In the 'Iliad' we see Greeks from many cities—Sparta, Athens, Thebes, Argos, and the rest—all more or less united to fight their common foe, Troy in Asia Minor (*see* Trojan War). In historical times the Greeks were again able to work more or less together when the power of Persia threatened them all. But Greece never became a nation. The only patriotism the Greek ever knew was loyalty to his city. This seems particularly strange to us nowadays, because their cities were so small. All the people of all of them could be put into the city of New York and hardly show. Except Athens, probably no Greek city-state counted more than 20,000 citizens, and most of them were less than half that size.

The reason for this disunity we have already touched upon. Just as Europe today is chopped up into nations instead of being a few large political units as North America is, so on a smaller scale ancient Greece was divided by its mountain ranges. And even the plains thus inclosed were in many cases subdivided, containing several city-states each surrounding its acropolis or citadel. These flat-topped, inaccessible rocks or mounds—which will remind you of the mesas of New Mexico—are characteristic of Greece, and were first used as places of refuge. Dwellers of the Corinthian isthmus had the lofty Acrocorinthus, of Attica the acropolis of Athens, of the plain of Argolis the mound of Tiryns, and loftier still the Larissa of Argos. On these rocks they built their temples and their king's palace, and their houses clustered about the base.

Only in a few cases did the city-state push its holdings beyond very narrow limits. Athens held the whole plain of Attica and most of the Attic villagers were Athenian citizens. Argos conquered the plain of Argolis. Sparta made a conquest of Laconia and part of the fertile plain of Messenia, the conquered people being subjects, not citizens. Thebes attempted to be the ruling city of Boeotia, but never quite succeeded.

Similar city-states were found through all the Greek world, which had early flung its outposts throughout the Aegean basin and even beyond. There were Greeks in all the islands of the Aegean: in Thasos, famous for its gold mines; in Samothrace, Imbros, and Lemnos, long occupied by Athenian colonists; in Lesbos, "where burning Sappho loved and sang," and Scyros the island of Achilles; in Chios, Samos, and Rhodes, as well as in the nearer-lying Cyclades—so called (from the Greek word for 'circle") because they formed a circle around the sacred island of Delos—and to the south in the island of Crete. The western shores of Asia Minor were fringed with Greek colonies, reaching out past the Propontis (Sea of Marmora) and the Bosporus to the northern and southern shores of the Euxine or Black Sea. In Africa there were, among others, the colony of Cyrene, and the trading post of Naucratis in Egypt. Sicily too was colonized by the Greeks, and there and in southern Italy so many colonies were planted that this region came to be known as Magna Graecia, or "Great Greece." Pressing farther still, the Greeks founded the city of Massilia, now Marseilles, in Gaul.

The Lack of Political Unity

Separated by barriers of sea and mountain, by local pride and jealousy, the various independent city-states never even conceived the idea of forming a political unit of the Greek-speaking world, except as some powerful state embarked on a career of conquest

GREEK CHILDREN AT PLAY

The houses of the Greeks were usually built around a court, which was the "front yard" of the family and the playground of the children. Not only did the youngsters find swinging as delightful an amusement as do the children of today, but their games and toys were very much like our own. Here we see an idealized picture of a Greek home, one such as belonged perhaps to some rich Athenian. The costume of the woman at the left indicates that she is the children's nurse.

and attempted to make itself mistress of the rest. Many influences made for unity—a common language, a common religion (*see* Mythology), a common literature, similar manners and customs, the religious leagues and festivals, the Olympic Games (*see* Olympic Games)—but even in time of foreign invasion it was with the greatest difficulty that the cities were induced to act together.

The government of many of the city-states—notably Athens—passes through four stages as we watch it from Homer to historical times. During the 8th and 7th centuries B.C. the kings disappear, monarchy gives way to oligarchy, that is, the rule of the few. The power goes over to the wealthy landowning nobles—the "Eupatrids" or well-born. But the rivalry among the nobles and the discontent of the oppressed masses are too great, and soon a third stage appears.

This third type of government is known as tyranny. Some Eupatrid suddenly seizes absolute power—usually by obtaining the favor of the people and promising to right the wrongs inflicted upon them by the other land-holding Eupatrids. He is known as a "tyrant," which among the Greeks was not a term of reproach, merely implying one who had seized kingly power without the qualification of royal descent. The tyrants of the 7th century were a stepping stone to democracy, or the rule of the people, which was nearly everywhere established in the 6th and 5th centuries. For it was the tyrant who taught the people their rights and their power.

By the beginning of the 5th century B.C. Athens had gone through these stages and emerged as a democracy—the first democracy in the history of the world. Between two and three centuries before this the kings had been displaced by officials called "archons," elected by the nobles, and the aristocratic form of government was established. About 621 B.C. an important step in the direction of democracy was taken, when the first written laws in Greece were compiled from the existing traditional laws. This reform was forced by the peasants to relieve them from the oppression of the nobles. But this code, which was so severe that the adjective "Draconic," from the name of its compiler Draco, is still a synonym for "harsh," did not give sufficient relief. A revolution was only averted by the wise reforms of Solon, about a generation later (*see* Solon). But Solon's reforms only put off the fatal day, and in 561 B.C. Pisistratus, aided by the discontented, made himself tyrant. With two interruptions, Pisistratus ruled for more than 30 years, fostering commerce, agriculture, and the arts, and laying the foundation for much of Athens' future greatness. His sons Hippias and Hipparchus attempted to continue their father's power, but one of them was slain by two youths, Harmodius and Aristogiton, who henceforth lived in Greek tradition as themes for sculptors and poets. By the reforms of Clisthenes, about 509, the nobles were shorn of much of their power, and the rule of the people was firmly established.

Very different was the course of events in Sparta (*see* Sparta), which had now established itself as the most powerful military state in Greece. Under the strict laws of Lycurgus (*see* Lycurgus) it had maintained its primitive monarchical form of government with little change. Nearly the whole of the Peloponnesus had been brought under its iron heel, and it was now jealously eyeing the rising power of its democratic rival in central Greece.

Suddenly there loomed in the east a thundercloud which threatened to sweep away the whole promising structure of the new European civilization. Persia, the great Asiatic world-empire of the day, had suddenly been awakened to the existence of the free peoples of Greece by the aid which the Athenians had sent to their oppressed kinsmen in Asia Minor. The dramatic story of how the scanty forces of the Greeks drove back the enormous Persian armaments is told in the article on the Persian Wars.

How Athens Rose to Power

From this momentous conflict Athens emerged a blackened ruin, but yet the richest and most powerful state in Greece. She owed this position chiefly to the shrewd policies of her statesman Themistocles, who had seen that naval strength, not land strength, was henceforth to be the key to power. "Whoso can hold the sea has command of the situation," he said. He persuaded his fellow Athenians to build a strong fleet—larger than the combined fleets of all the rest of Greece—and to fortify the harbor at Piraeus. This fleet became the instrument by which the Persians were finally defeated at the battle of Salamis, and also by which Athens made herself mistress of the Aegean. For, within three years after Salamis (480 B.C.), Athens had united the Greek cities of the Asiatic coast and of the Aegean islands into a confederacy (called the Delian League because the treasury was at first on the island of Delos) for defense against Persia; and in another generation this confederacy had become an Athenian Empire.

Almost at a stride Athens was transformed from a provincial city to an imperial capital. The bewildering rapidity of her leap to power makes us think of the transformation of Japan in the second half of the 19th century. Wealth beyond the dreams of any other Greek state flowed into her coffers—tribute from subject and allied states, customs duties on the flood of commerce that poured through the Piraeus, and revenues from the Attic silver mines. The population increased fourfold or more, as foreigners streamed in to share in the prosperity. Learning and the arts flourished as never before in history. Painters and sculptors vied in beautifying Athens with the works of their genius—treasures which even today, battered and defaced by time and man, still remain among the wonder works of human skill.

This period, which stands out as one of the most remarkable and brilliant in the world's history, reached its culmination in the age of Pericles, 460–430 B.C. (*see* Pericles). Under the stimulus of wealth, power, abundant leisure, and free institutions, the citizen body of Athens attained a higher average of intelligence than any other society before or since. Sir Francis Galton, the eminent English scientist and anthropologist, says of them: "The average ability of the Athenian race is, on the lowest possible estimate, very nearly two grades higher than our own, that is, about as much as our race is above that of the African negro. This estimate is confirmed by the quick intelligence and high culture of the Athenian commonalty, before whom literary works were recited and works of art exhibited of a far more severe character than could possibly be appreciated by the average of our race."

But we must remember that a very large part of the Athenian population were not citizens, for the Athenian state rested on a foundation of slavery. Two-fifths (some authorities say four-fifths) of the population were slaves (often if not usually themselves of Greek blood) whose labor produced a large part of the wealth that gave the citizen the time and money to pursue art and learning and serve the state.

Slavery in Greece was a peculiar institution. When a city was conquered its inhabitants were often sold as slaves. Kidnaping boys and men in "barbarian," that is, non-Greek lands, and even in other Greek states, was another steady source of supply. If a slave was well educated or could be trained to a craft, he was easily disposed of. And a slave always had a chance of obtaining his freedom, for quite frequently his master would let him work for hire and this gave him a chance to save money. After he had bought his freedom or had been set free by a grateful master, he became simply a "metic"—a resident alien. Many of the slaves who could not be trained, however, had a miserable lot. They were sent in gangs to the silver mines at Laurium, where they worked underground by the dim light of little olive oil lamps in narrow corridors.

Life in the Periclean Age

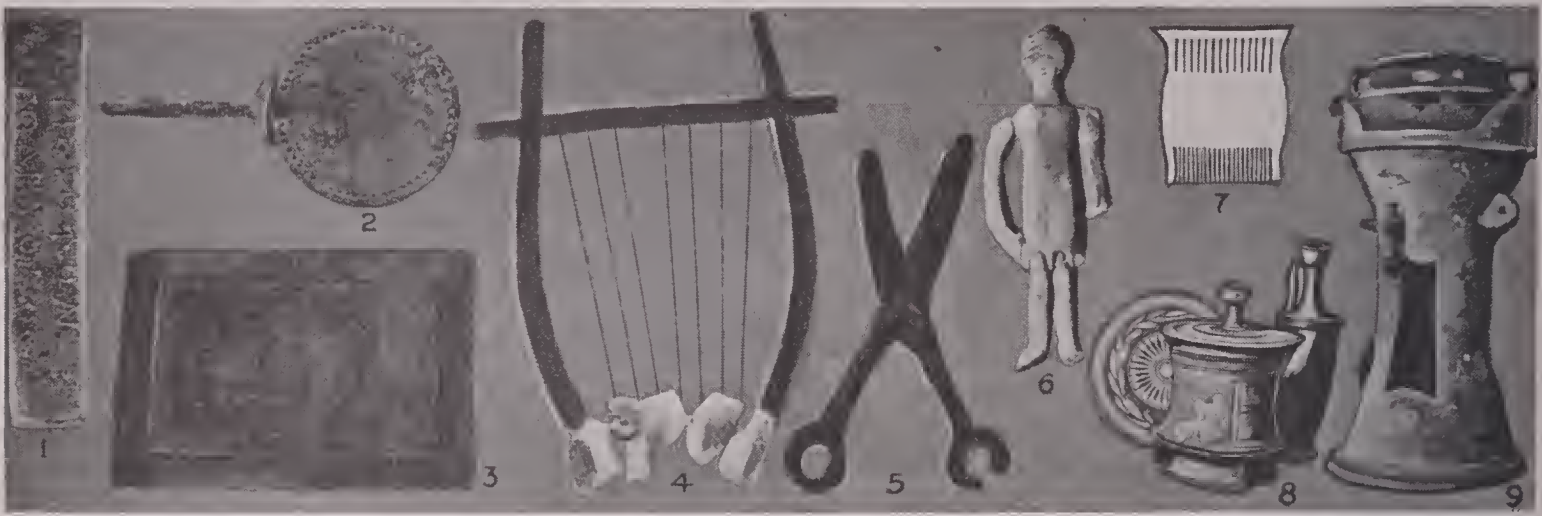
Though the citizens of Athens were thus set free from much of the drudgery of life, we must not get the idea that they reveled in luxury. "Plain living and high thinking" might have been their motto, for the standard of comfort was very low, in comparison with our own. The houses were of sun-dried brick, built two stories high along narrow winding streets, into which refuse was thrown instead of being properly drained or carted off. The people ate two meals a day, each consisting of bread, perhaps a broth of beans and pulse, with wine and sometimes

A YOUNG ATHLETE IN THE MAKING

Training of the body occupied just as important a place in the Greek system of education as the training of the mind, and that same fine and gracious character which marked other aspects of their life was also present in their athletic contests and games. This picture by Lord Leighton, former president of the British Royal Academy, shows a young man instructing a boy in the art of shooting with the bow.

fruit to wash it down. Fish with the bread was thought to make a remarkably fine meal. Olives and olive oil were largely used; honey took the place of sugar; and cheese was often eaten in place of meat, but butter was practically unknown. Athens can be nearly as cold in winter as Philadelphia, yet the only heat in the houses was a brazier or dish of burning charcoal. There was no plumbing, nor were there chimneys, and the smoke from the stove in the tiny kitchen sometimes preferred wandering around the house to going out the hole in the roof provided for it. There were no windows on the first floor, but in the center of the house was a broad open court—as you will find in Spain or in the oriental countries today—with the men's apartment, the women's apartment, and the tiny cupboard-like bedrooms clustered about it. The second story sometimes had a window or two looking down upon the street.

RELICS OF THE DAYS OF THE ANCIENT GREEKS



1. Fragment of pottery on which an Athenian juryman inscribed his verdict in a court trial. 2. Hand mirror, the reflecting part made of polished metal. 3. Waxed tablet on which some Greek school boy had scratched his multiplication table. 4. Lyre. 5. A pair of scissors. 6. Doll made of clay. 7. Comb. 8. Platter, toilet box, and oil flask. 9. Movable oven with a cooking pot fitting into the top.

The Gossip of the Market Place

But the real life of the city was out of doors. The men spent much of their time talking politics and philosophy in the agora or market place, exercising or lounging in the athletic fields, performing military duty, sitting in the Assembly or the Council of 500, taking part in the numerous state festivals, or doing jury duty—there were 6,000 jurors on duty all the time in Athens, for all the allied cities were forced to bring their cases to Athens for trial. Daily salaries were paid for jury service and service on the Council, which made up a considerable part of the income of the poorer citizens. The women stayed at home, attending to the affairs of the house and spinning and weaving the wool for clothing. They never acted as hostess when their husbands had parties, and were only seen in public at the theater—where they might attend tragedy but not comedy—and at certain religious festivals.

Such was life in Athens in the heyday of her glory, before the jealousy of Sparta and other independent Greek states, and the discontent of the subject states of the Athenian Empire, flamed up into a war that forever broke the power of Athens and left her a mere shadow of her former greatness. Already the first of the inevitable clashes between imperial Athens and her rivals, chief of whom was Sparta, had wasted the strength of most of Greece for 15 years of indecisive struggle. This was the first of the Peloponnesian Wars (459–446), which were to the Greek world what the World War of 1914–18 was to our own. In 431, in spite of the exhaustion of both sides, war again broke out.

The plan of Pericles in the Second Peloponnesian War was not to fight at all, but to let Corinth and Sparta spend their money and energies while Athens conserved both. Therefore he had all the inhabitants of Attica come inside the walls of Athens and let the Peloponnesians enter the plain of Attica year after year and ravage as they would, while Athens, again without losses, harried their lands by sea. But Pericles reckoned without the dangers of overcrowding. The plague broke out in Athens and killed one-fourth of the population, including Pericles himself, and left the other three-fourths without spirit and without a leader. After dragging along for ten years, this war ended with the supremacy still undecided.

Alcibiades and His Evil Influence

Almost before they knew it, however, the Athenians were whirled by the unscrupulous demagogue Alcibiades, nephew of Pericles, into the Third Peloponnesian War. Wishing for a brilliant military career Alcibiades persuaded Athens into a stupendous expedition against Syracuse, a Corinthian colony in Sicily. The greatness of the Athenian armament reminds us of the Invincible Armada that was sent by Spain against England in Queen Elizabeth's time. And it suffered an equally overwhelming disaster in 413 B.C., being completely destroyed, while the Athenian captives were sold into slavery.

This disaster sealed the fate of Athens. Those of the subjects or allied cities about the Aegean that had remained faithful now deserted to Sparta, and the Spartans laid Athens under siege. In 405 B.C. the whole remaining Athenian fleet of 180 triremes was captured in the Hellespont at the battle of Aegospotami. Besieged by land and powerless by sea, Athens could neither raise grain nor import it, and in 404 B.C. the Athenian Empire came to an end. The fortifications and long walls connecting Athens with Piraeus were destroyed, and Athens became a vassal ally of triumphant Sparta.

Sparta maintained its supremacy by keeping Spartan garrisons in many of the Greek cities, and this custom together with Sparta's hatred of democracy made its domination unpopular. After various unsuccessful attempts to shake off its heavy hand, Thebes at length succeeded (*see* Thebes). At the battle of Leuctra in 371 B.C. the Thebans under their gifted commander Epaminondas brought Spartan power to an end. The era of Theban hegemony or leadership was, however, short-lived, for the Theban power was the one-man power of Epaminondas, and when he was killed in the battle of Mantinea in 362 B.C. Thebes really suffered defeat in spite of its victory. The age of the powerful city-states was at an end, and a prostrated Greece invited a conqueror.

Such a conqueror was found in the young and strong country of Macedon, lying just to the north of classical Greece. Its king Philip, who came into power in 360 B.C., had had a Greek education and, seeing the weakness of the disunited cities, made up his mind to possess the Greek world. Demosthenes (*see* Demosthenes) saw the danger that threatened and by a series of fiery speeches against Philip sought to unite the Greeks as they had once been united against Persia. But Philip was too strong for them and at the battle of Chaeronea (338) established his leadership. Before he could carry his conquests to Asia Minor, however, he was killed and his power fell to his son Alexander, then not quite 20 years old. How Alexander firmly established himself throughout Greece, and then overthrew the vast power of Persia, building up an empire that embraced nearly the entire known world, is told in a separate article.

CLINGING CLOTH CARVED FROM THE SOLID STONE

These three figures from the ruins of the Parthenon in Athens, and now in the British Museum, are generally supposed to present the finest treatment of drapery known to the sculptor's art. Mutilated as they are, the exact meaning of these figures remains a mystery. They are commonly called "The Three Fates," but another interesting theory is that the reclining form is that of Thalassa "the Sea," lying in the lap of Gaia "the Earth," and that the exquisite flowing lines of drapery represent the waves breaking upon the shore. According to this theory, the figure at the left did not belong to the group.

Alexander made the whole face of the world Greek as he organized his conquests. What he did is a heritage for us to this day, for by imposing the West upon the East he prevented the East's imposing itself upon the West. Greek culture means freedom of spirit, and, as the Romans put it, a healthy mind in a healthy body. The East was a great system of enslavement. Masses of weltering humanity were driven to battle by the lash. They were forced to build palaces under the tropical sun and to make sculptures of prodigious size for the glory of one man, but they took no such joy in any of their work as the Athenians did in their beautiful Acropolis.

The three centuries that follow the death of Alexander are known as the Hellenistic age, for their products were no longer pure Greek, but Greek plus the characteristics of the conquered nations. It was a time of great wealth and splendor. Art, science, and letters flourished and developed. The private citizen no longer lived crudely, but in a beautiful and comfortable house, and many cities adorned themselves with beautiful public buildings and sculptures.

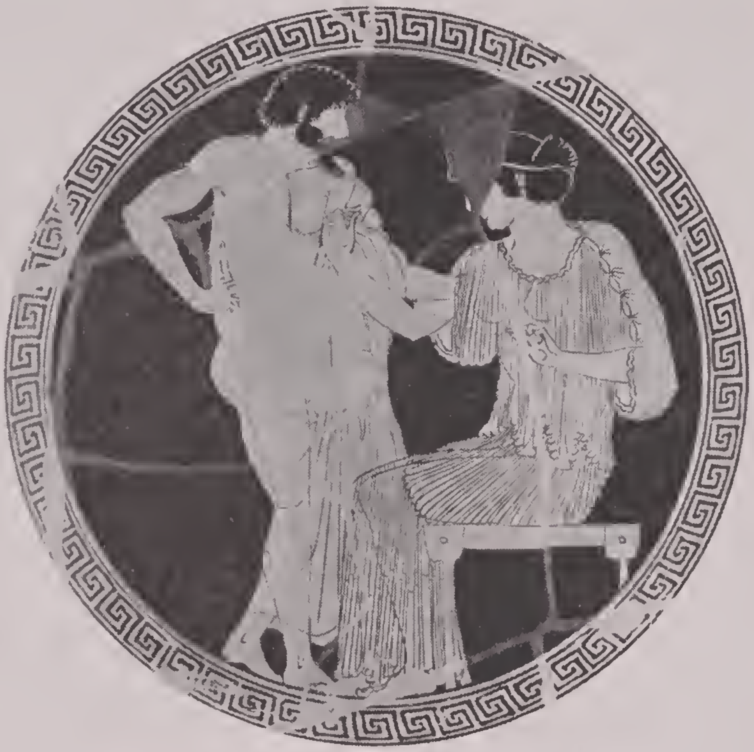
This age came to its end in another conquest—that of Rome. On the field of Cynoscephalae ("dogs' heads"), in Thessaly, the Romans defeated Macedonia in 197 B.C. and gave the Greek cities their freedom as allies. Even so the Greeks caused Rome a great deal of trouble, and were taught their lesson by the burning of Corinth in 146 B.C. and their reduction to vassalage. Athens alone was revered and allowed a certain amount of freedom, and to its schools went many Romans, Cicero among them.

For more than 2,000 years, from the time of Alexander the Great to the third decade of the 19th century, the Greeks passed from one master to another. The last of these conquerors was Turkey, which established its dominion during the 15th century. At the beginning of the 19th century the power of Turkey was waning. Revolts by subject peoples and by the outlying parts of the empire itself were becoming more and more frequent. In 1821 the Greek nation as a whole, stirred by the example of the French Revolution, rose in arms in the Greek War of Independence. Russia was interested because the Greek Catholic church was also the state church of Russia, and Russia had for years claimed the right to protect the Greek Christian subjects of the Turkish Empire. Numerous volunteers from Europe joined the Greeks —Lord Byron among them — and fought the troops of the sultan with varying success. There were terrible massacres committed on both sides. In 1827 the Turkish fleet was destroyed at Navarino by the combined British, French, and Russian fleets, but there the joint action ceased. Next year Russia took matters into her own hands, marched an army into the Balkans, and took Adrianople. In the peace of Adrianople (1829) Turkey signed a peace whose outcome was the restoration of independence to the Greeks, after centuries of oppression by foreign powers.

In 1832 after serious disorders and the murder of its provisional president, the three protecting powers raised to the throne of Greece Prince Otto, son of Louis I of Bavaria. Otto, however, ruled after the German manner, with German advisers, and the Greeks in 1862 revolted and deposed him. In the following year Prince George of Denmark became king and reigned until his assassination in 1913. In 1864 Great Britain ceded to Greece the Ionian Islands, which had been a republic under British protection since 1815. The scanted original kingdom was further enlarged by the addition of Thessaly on the north, between 1881 and 1897. Crete, which had revolted from Turkish rule, was not allowed by the powers to become a part of Greece until 1913. Brigandage was not put down until 1870, and it was not until 1916 that the 56-mile link was completed that now connects the Greek railways with those of the rest of Europe.

In the Balkan War of 1912–13, the allied Balkan states thoroughly defeated Turkey, and Greece gained a broad strip of territory on the north, amounting to 21,000 square miles and including a great part of ancient Macedonia (*see* Balkan Peninsula). This was the greatest expansion the kingdom had experienced since its founding in 1862. In the World War of 1914–18 Greece proclaimed neutrality; but King Constantine, who was married to the sister of Emperor William II of Germany, was accused by the Allies of secretly aiding the Central Powers. Prime Minister Venizelos, a most brilliant statesman who had piloted his country through the Balkan Wars, revolted after he had twice been dismissed unconstitutionally by the king; and in June 1917, King Constantine was forced by the Allies to abdicate in favor of his second son, Alexander, and leave the country. In the peace settlement which followed the close of the war Venizelos obtained exceedingly favorable terms for Greece, including the annexation of Thrace to the Black Sea (including Adrianople), together with Smyrna and a large adjacent district in Asia Minor (for map *see* Balkan Peninsula). But in December 1920, following the death of Alexander from the bite of a pet monkey, Constantine was restored by an overwhelming vote of the Greek people, and thereby Greece forfeited the support of the Allied powers. The Greek government attempted single-handed to enforce their claims to the lands granted them in Asia Minor, but their armies were defeated by Turkish nationalists in 1921, and the whole position of Greece was shaken.

HOW THE GREEKS DECORATED POTTERY



This is part of the decoration of an ancient Greek vase, pieced together from broken fragments. In this type of work the background was painted black, and the details of the figures sketched in with black lines, while the remainder was simply left in the color of the clay. The delicacy and sureness of line on these vases is universally admired.

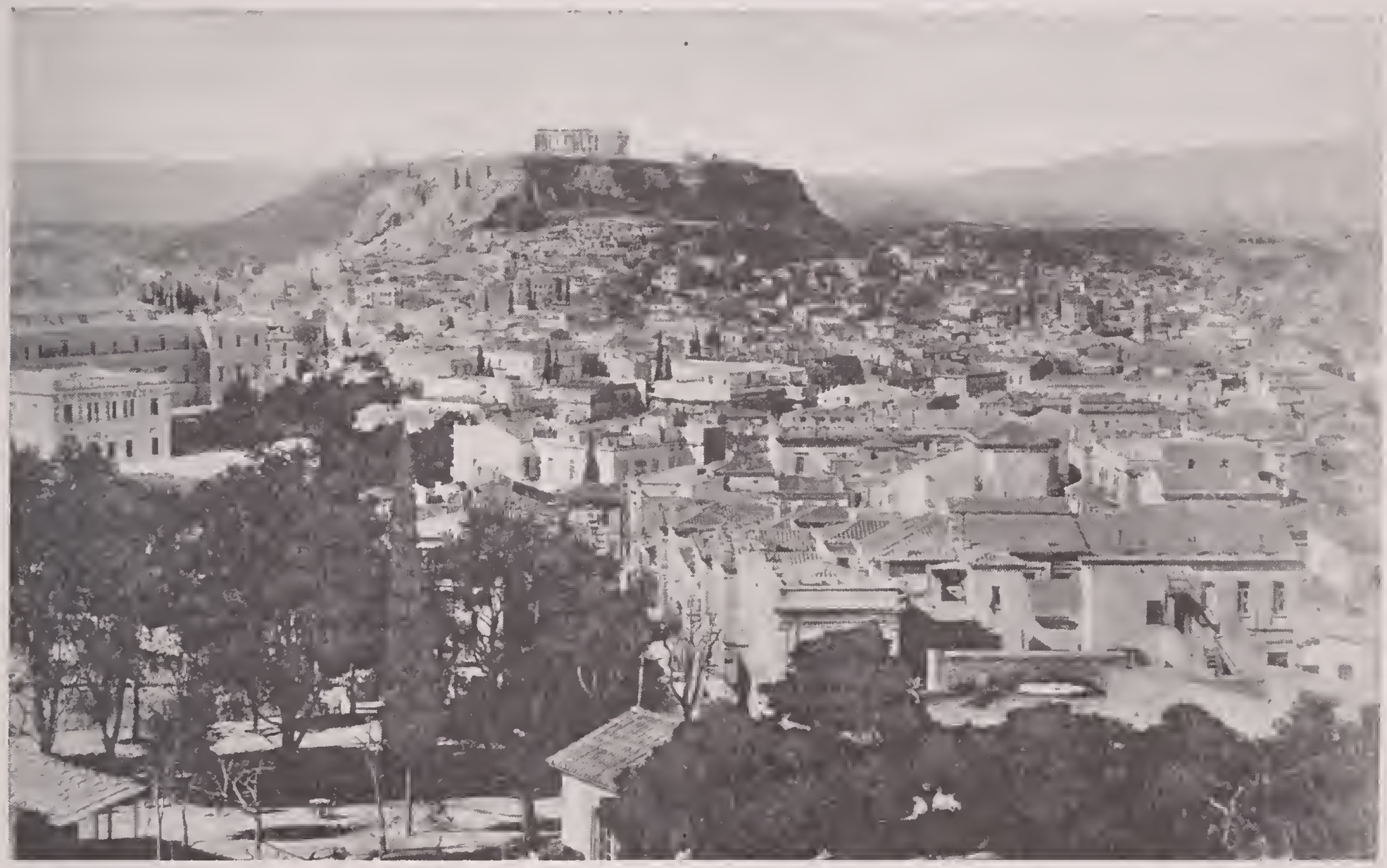
The Greek constitution adopted Oct. 29, 1864, placed the legislative power in the hands of a single assembly elected by manhood suffrage. In 1911 this constitution was modified to provide for a second chamber by reëstablishing the Council of State.

And now let us make a flying visit to the land whose fortunes we have been following through 30 centuries. Should you try to take a walking trip through Greece you will find, outside of Athens, few comfortable hotels. After an afternoon's tramp over stony roads, you will perhaps stop at some *khan*, and find that the cooking is done at the hearth before which you will roll yourself up in a blanket to sleep. At such country inns you will not find the delicious Greek-Turkish cookery of Athens—*pilaf*, which is rice prepared with minced mutton or chicken and pastry made with honey. You will be lucky to get coarse dark bread and goat's milk cheese, and a few preserved olives, washed down with the native wine which tastes strongly of the resin put in to preserve it.

visitor readily appreciates the beautiful location of what is now just a country town. It is surrounded by mountains, with the famous Helicon and Parnassus on the west. To the northwest lies Lake Copais, which formerly was a shallow and unhealthy sheet of water and marsh but now has been drained, redeeming 60,000 acres of fertile land.

The most interesting excavations in Greece are in the Peloponnesus at Olympia, which may be reached by rail from Corinth. As you journey along the Gulf of Corinth you will see luxuriant vineyards and dazzling white fields set apart for drying currants.

THE CITY OF ATHENS AS IT IS TODAY



We are looking across the tiled roofs of modern Athens at the Acropolis with the ruins of the Parthenon on its flat summit. In ancient Athens the favorite section for residences was in this region northeast of the Acropolis and the Athenians of today have followed the examples of their ancestors. In the foreground at the left is the Royal Palace.

An hour or so by train from Athens will take you to the mines at Laurion, from which came the silver to pay for Themistocles' "wooden wall"—the fleet which made Athens head of an empire. A Greek and a French company are working these mines today and a guide will take you through some of the 2,000 ancient galleries that lie side by side with the newer ones. The old slag heaps are being smelted over, not so much for silver as for lead and other metals that the ancient Greeks failed to extract.

Of Thebes and Corinth, the ancient neighbors and rivals of Athens, and of Sparta, the more distant enemy city, the earthquakes and other accidents of 2,000 years have left little now standing. But although the archaeologists have no hope of ever locating the famous seven gates of Thebes, the

Tall dark cypresses and mountain torrents add to the beauty of the landscape. The currant industry became so profitable in the late 1870's when phylloxera attacked the vines of France that Greek agriculturists cut down their precious olive groves—it takes 60 years for an olive tree to reach maturity—in order that they might plant more currants. And ever since the French vines recovered, the Greek government has had the problem of superfluous currants to deal with. At first the government took over a percentage of the crop, but recently it has passed a law limiting production and ordering the digging up of thousands of acres of vines.

Olympia, like Pompeii, is a buried city which modern enterprise has brought to light. In the three centuries following the last celebration of the Olympic

Games, in the 4th century A.D., the chief temples were overthrown by earthquakes, the treasuries were covered by a landslip, and the whole site buried under two or three layers of sand by the two rivers at whose junction it lies. In the museum there you will find the original Hermes of Praxiteles, one of the greatest pieces of ancient sculpture that has come down to us.

Other important finds have been made at Delphi, once the site of the famous oracle (*see* Delphi). You will enjoy a visit to this beautiful spot on the northern shore of the Corinthian gulf, whose cold springs and cool air currents from the chasms of Mount Parnassus early excited the awe of the Greeks. You will be disappointed, however, if you have come with an old guide book, for the Castalian spring was filled up by an earthquake in 1894.

A visit to the little island of Aegina about 15 miles southwest of Athens will also be well worth while. This has a prosperous agricultural and fishing community, famous for its pottery, and for the sponge fishing carried on by divers in the spring and summer. But it is most interesting for the remains of its splendid temple of Zeus.

Some day when the Aegean Sea is propitious you will sail from the Piraeus to visit the Cyclades Islands, especially Delos. This little island, uninhabited today except by a few shepherds and the custodian of the excavations, is rich in archaeological interest—temples, a theater, and a house with a mosaic floor, and the fragments of a very old colossal statue of Apollo which stood in the sacred precinct near the Apollo temple, in the days of the Delian League. If you climb to the top of Mount Kynthos you can see other islands of the group round about, including Naxos, the largest and most fertile, and Paros, still famous for its marble.

Relics of Many Ages

Side by side with the antiquities of Greece you will often find Byzantine churches, medieval monasteries of the Greek Catholic church, and ruins of "Frankish" castles, erected in the days following the crusade of 1204, when barons from western Europe ruled parts of the land. In 1829 some 300 of the smaller monasteries were suppressed and their buildings allowed to fall into decay. But there are still scores of monasteries in Greece, and in traveling about you will often seek the hospitality of the monks instead of putting up at doubtful khans—even in Saloniki, the "queen city of the Aegean" (*see* Saloniki). The monasteries of the mountainous promontory of Athos are world famous, and the Meteora in Thessaly the most curious. The visitor is usually swung up the top of these rocky pinnacles by a basket and windlass, instead of being asked to climb the dizzy ladders.

The Greek Orthodox church, although nominally under the Patriarchiate of Constantinople, is really a free national church. Its growing separation from the Roman Catholic church, arising in part from differences of language and civilization, became definite in 1054. Aside from the refusal of the Greek church to recognize the supremacy of the pope, there are other differences—marriage allowed to Greek priests (forbidden to Roman Catholic clergy), use of leavened instead of unleavened bread in the sacrament of the Mass, a slight difference of doctrine concerning the Holy Ghost, etc.

The Greeks today are a scattered race, like the Jews; but in whatever part of the globe they may be they show an intense love of Greece. In one battle in the Balkan War 7,000 Greeks who were American citizens died fighting against the Bulgars; and it is the usual ideal of the Greeks whom we see in the United States in their little fruit, flower, and candy shops to make a sufficient fortune to enable them to go back to Greece to live.

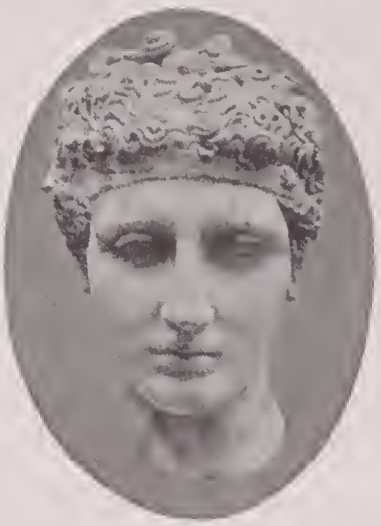
Races of Modern Greece

In addition to the Greek-speaking element of the population, which represents the parent Greek stock much modified by Slávic and other racial mixtures, Greece today is inhabited by two other wholly distinct racial groups. All over the Attic plain, Corinthia, Argolis, and in various other parts, are found the Albanians, who are chiefly farmers. They are a vigorous and manly race, who make excellent soldiers and sailors and have furnished many famous leaders to the kingdom, though they are less quick-witted than the true Greeks (*see* Albania). The Vlachs, who are found chiefly in the mountains of Thessaly and central Greece, are for the most part nomad herdsmen or carriers; descended from the Latinized population of Roman times, they still speak a language which indicates its Latin origin.

More than half the people are employed in agriculture and kindred pursuits. Owing to the destruction of the forests, and the consequent denudation of the soil and impoverishment of water supply, the arable area is considerably less than in classical times. Where there is sufficient natural water, or where irrigation is practiced, however, bountiful crops are raised. More than half the arable area is devoted to stock-raising, chiefly sheep and goats, as of old. One-fifth of the surface of the mainland is still forested. Methods of agriculture are still for the most part of the most primitive kind. In many places the old wooden plow—precisely as it was 2,500 years ago—is still employed. The use of fertilizers and rotation of crops is rare, and the fields are generally allowed to lie fallow in alternate years. The result is that Greece has to import a considerable proportion of its food, especially cereals.

The absence of good native coal has retarded manufacturing, though textiles, leather goods, soap, paper, glass, and some other articles are manufactured, in addition to olive oil and wine. Shipbuilding is carried on at all the ports, for a large part of the nation's wealth today comes from its carrying trade. The Greeks are shrewd traders and monopolize a considerable proportion of the commerce of the Mediterranean region.

The GLORIOUS ART *of* GREECE *and How* ROME *Helped Transmit It to Us*



THE poet tells us that "A thing of beauty is a joy forever." More than 20 centuries ago the ancient Greeks, inspired by lofty ideals of Beauty, Truth, and Goodness, which in their simple and harmonious view of life were inseparable, created works of art which have never been equaled. Worn and defaced by time, these art works are still so beautiful that to look upon them is an inspiration. Many men have spent the best part of their lives searching for these beautiful fragments and thus helping to piece out the story of Greek art. Something of this wonderful story — the conditions under which Greek art was born, its development, and the great masters and their work—is told in this article. It tells, too, how when Greece fell her beauty held captive the practical-minded Roman conquerors; how, under her influence, the Romans developed an art of their own, and also helped to transmit to later ages the unsurpassed glory of the art of the Greeks.

GREEK AND ROMAN ART. Greek art owes a great deal to natural conditions. Greece is one of the fairest lands in all the world; nowhere else has Nature brought together the charm of mountains and sea and sky in more beautiful combination. The firm lines of mountains and crags outlined in the crystal-clear air against the brilliant blue of the sky must have helped to inspire that love of simple graceful line, of perfect proportion and symmetry, of strength and serenity, which is characteristic of Greek architecture and sculpture. Responding to the beauty that was everywhere about him, the Greek aspired to make his mind and his body harmonious and beautiful as Nature. It is impossible to measure how much the sculptor owed to the Greek emphasis of physical culture and athletics. And Nature endowed the Greeks in another important way; for many of the islands off the coast, notably Paros, are almost solid blocks of white marble, while in Attica the quarries of Mount Pentelicus and Mount Hymettus also yield an abundance of the beautiful white stone which invites the sculptor's chisel.

But we must not think that cold white marble alone satisfied the Greeks. They used color in both their sculpture and their architecture, though time has almost entirely washed away the reds and blues and other bright hues with which they touched up their work, and we can only imagine what the effect must have been when those works were in their prime. The work of the great Greek painters also has disappeared, and lives only in what the ancient writers tell us about it and in the work of their disciples of a later day. Polygnotus in the 5th century, we are told, was renowned as a draughtsman; while the great painters of the 4th century—Parrhasius, Xeuxis, and Apelles—were famous as colorists.

Fortunately many Greek vases have been preserved in tombs and in other sites uncovered by modern excavators. Simple and graceful in form, these vases show in the earliest specimens geometric designs; then figures of men and gods, painted in black against the natural red of the clay, or, as later became more common, with the figures left red against a black background. From these vases we are able to form some idea of what Greek painting was like, and they give us further examples of that wonderful feeling for form and line which made the Greeks supreme in the field of sculpture.

We must not imagine that Greek art sprang fullblown into being. The ancestors of those artists who were to create the most perfect forms of sculpture that the world has ever seen were a semi-barbarous people, when they began to migrate into the peninsula that is now Greece; and centuries rolled by before their genius flowered into the art forms which have been the admiration of all later times. Though they must unconsciously have been influenced by the art of the Aegean peoples whom they overwhelmed, no relation can be traced between the well-wrought figures and reliefs of Tiryns and Mycenae and Cnossus, and the crude beginnings of Hellenic sculpture in the 7th century B.C. When we see how primitive and stiff are the Greek statues of that archaic period, and compare them with the masterpieces of two centuries later, we cannot but marvel at the rapid development of Greek art, when once it got fairly under way. Through the Phoenicians, the great trafficking race of the age, the early Greeks came in contact with the art of Babylonia, Assyria, and Egypt. They borrowed many of their decorative forms from these peoples, but transformed them by the fires of their own superb powers.

Greek religion, Greek love of beauty, and a growing spirit of nationality were finding fuller and fuller expression. But it took a storm like the Persian invasion (490–479 B.C.) to arouse the young virile race to great achievements. Having driven out the Asiatic invader, the Greeks suddenly grew, in the 5th century, to full stature. What the Persians had destroyed the Greeks set to work to rebuild. Their poets sang the glories of the new epoch, and Greek genius, as shown in the great creations at Athens, came to full strength and beauty. It was then, under Pericles, the great statesman and patron of art, that the Athenian Acropolis was restored and adorned with the matchless Parthenon, the Erechtheum, and other beautiful buildings. (*See* Acropolis; Athens.) There were beautiful temples in other cities of Greece, too, notably that of Zeus at Olympia, which we know from descriptions by the ancient writers and from a few fragments that have been discovered in recent times. (For Greek architecture *see* Architecture.)

AN ANCESTOR OF THE VENUS DE MILO

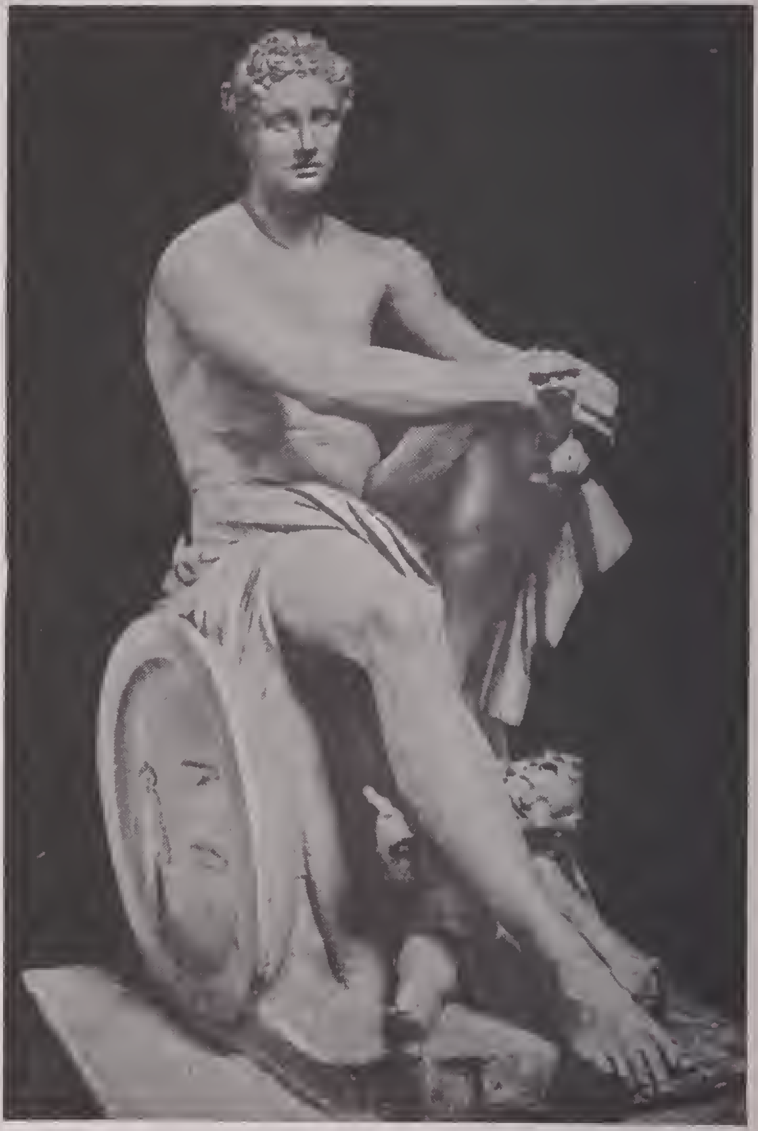
This quaint old lady is an example of very early Greek sculpture. It is hard to realize that from such crude beginnings developed the art which created the Venus de Milo.

The 5th century was made illustrious in sculpture also by the work of three great masters, all known to us in some degree by surviving works. Myron is famous for the boldness with which he fixed moments of violent action in marble, as in his famous 'Discobolus', or Disk-Thrower, which we know through a fine copy preserved at Rome. The 'Doryphorus', or Spear-Bearer, of Polyclitus, who worked in bronze, was called by the ancients the Rule, or guide in composition, because it was believed to follow the true proportions of the human body more perfectly than any other work.

But the greatest name in Greek sculpture is that of Phidias, who expressed in his marvelous works the noblest and loftiest ideals of Greek religion (*see* Phidias). It was under his direction that the sculptures decorating the Parthenon were planned and executed, and some of them may have been the work of his own hand. His great masterpieces, the colossal gold and ivory statue of Athena, which stood within this temple, and the similar one of Zeus in the temple at Olympia, have disappeared. But we can form some conception of his great genius from the remains of the sculptures of the pediments and frieze of the Parthenon, now preserved in the British Museum and known as the Elgin Marbles, from Lord Elgin who brought them from Athens in 1801–12. These sculptures, in their composition, in their exquisite modeling, and in the noble ideas which they embody, are the greatest works of Greek art that have come down to us. Another famous work that is believed to belong to the school of Phidias is the 'Aphrodite' of Melos, commonly known as the Venus de Milo, a marble statue now in the Louvre in Paris. Although some think it belongs to a later date, its perfect proportions, its calm dignity, and noble serenity typify the qualities which we associate with Phidias.

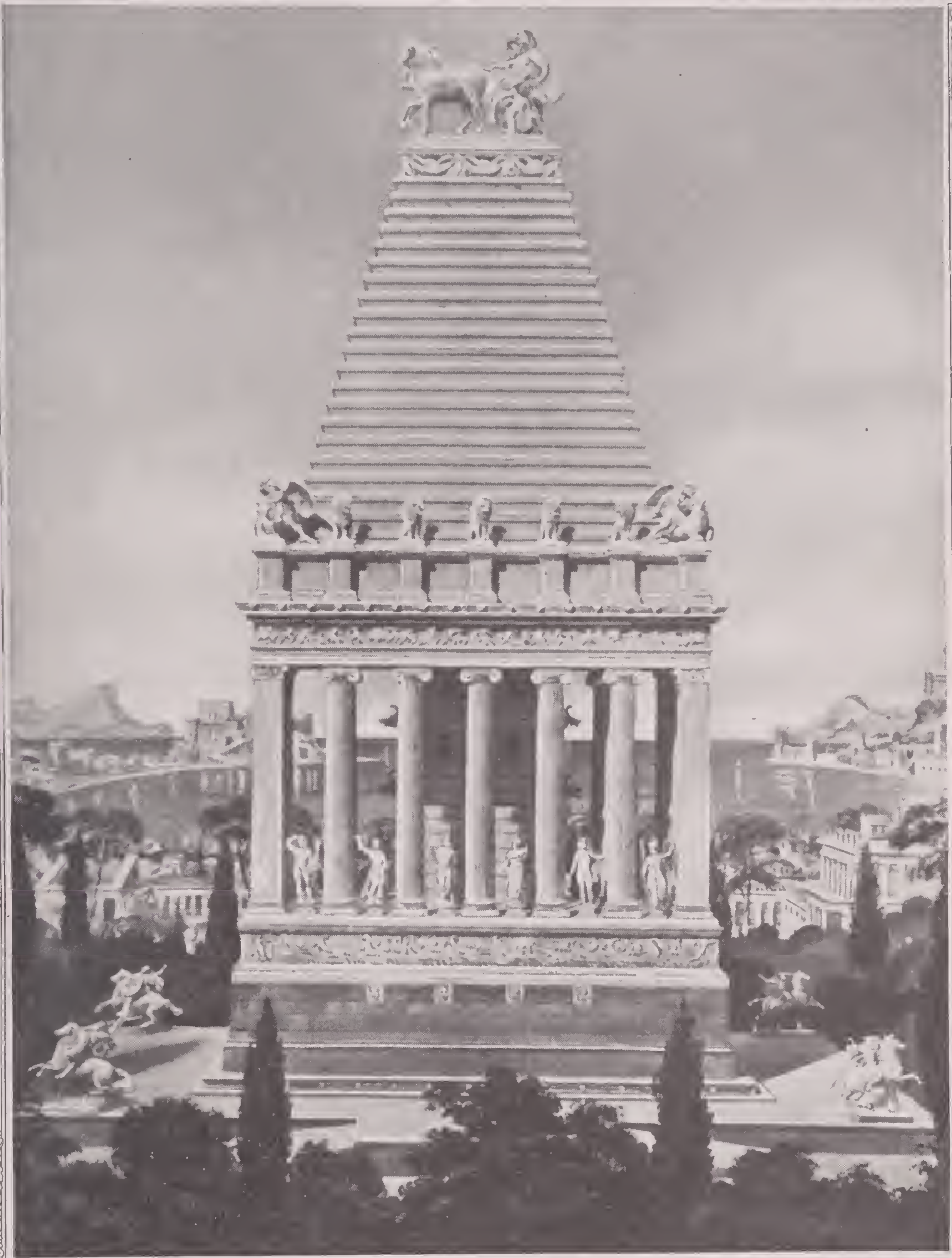
Phidias was followed by Praxiteles, Scopas, and Lysippus. Of Praxiteles, who has been called "the sculptor of the beautiful," we have an original work, the statue of 'Hermes with the Child Dionysus', the only existing statue which we know certainly to be the work of one of the great Greek masters. Most of the sculptors, it must be remembered, are known to us only through copies of their work by Roman artists. The figure of Hermes, at once strong and active and graceful, beautifully proportioned, with a surface of exquisite texture, the well-poised head and the face expressive of nobility and sweetness, is beautiful beyond description. The child which is held in the left hand is reaching out to grasp something, perhaps a bunch of grapes—held in the missing hand of Hermes. The so-called Satyr or Faun of Praxiteles, which suggested Hawthorne's 'Marble Faun', is probably the work of another sculptor of

THE GOD OF WAR AT REST



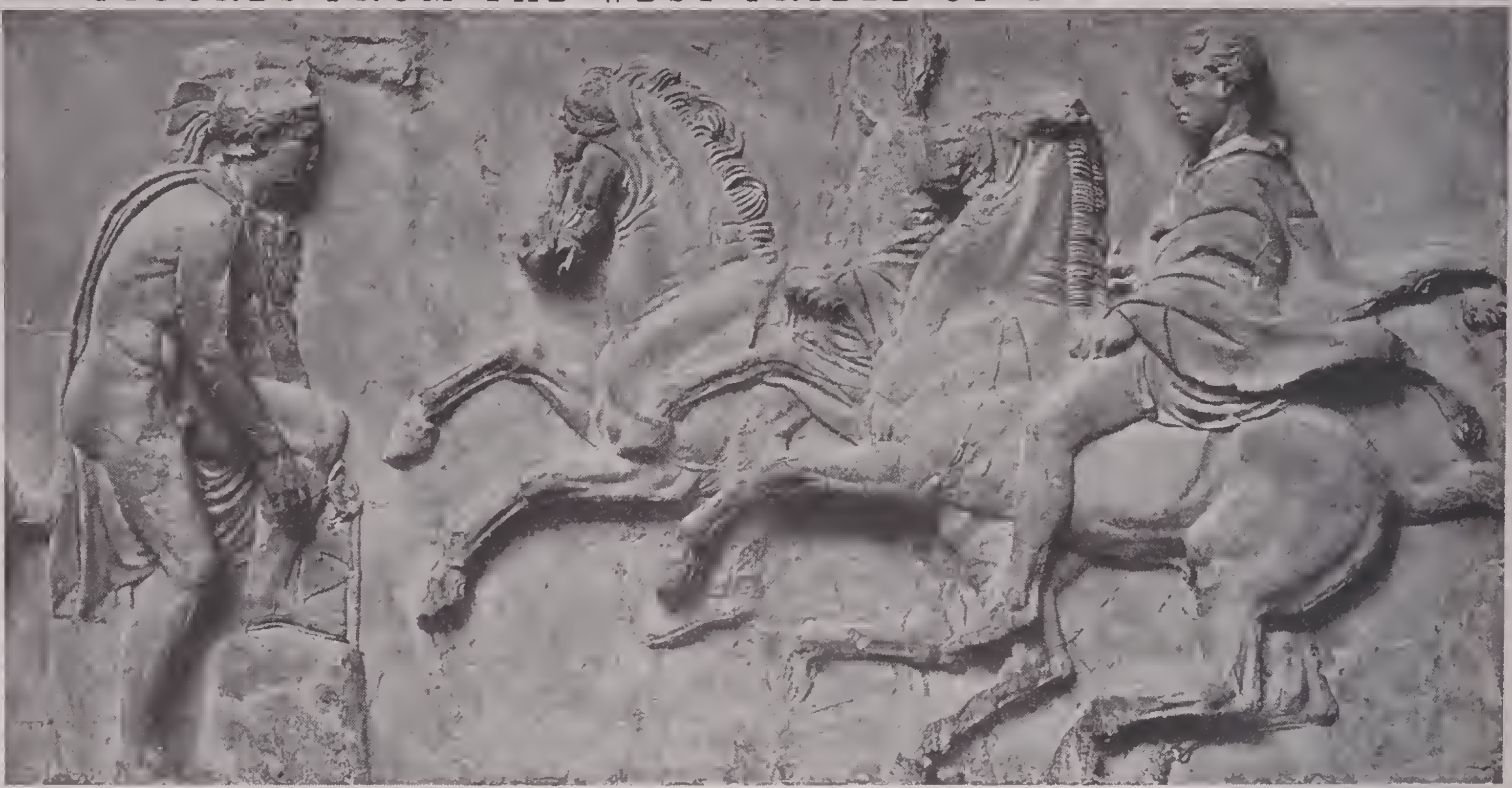
Compare this wonderful statue of the god Ares (Mars) with the crude figure at the left, and you will appreciate what progress the Greeks made in art in the course of a few centuries. This statue, the famous 'Villa Ludovisi Mars', is believed to be a copy of an original by Scopas or Lysippus. It is an excellent example of the characteristic "restraint" of Greek art. To show the violent character of the God of War, the sculptor merely extended the breadth of his nostrils, as men dilate them in anger. Playing at his feet is the little God of Love.

THE MOST FAMOUS TOMB OF ANCIENT TIMES



This tomb was built about 350 B.C. at Halicarnassus for King Mausolus of Caria by his widow, Artemisia. It was one of the Seven Wonders of the World, and one of the finest products of later Greek art. Designed by the architect and sculptor Pythis, it was richly adorned by Scopas and other noted sculptors. So great was the fame of this tomb that down to our own day all large and imposing burial places are called "mausoleums," after the ancient king whose bones rested here. This picture is an ideal restoration from the ruins.

FIGURES FROM THE WEST FRIEZE OF THE PARTHENON



Greek Art reached its climax in the Parthenon. Here we see three of the figures in the frieze on the west front, where the great "Panathenaic Procession" is represented as starting. Here the young soldiers are mounting or preparing to mount, one of them stooping to fasten his sandal. Notice the spirited action of these classic steeds of stone. The Greeks did not think it appropriate for horses to walk quietly in a procession. To do justice to the occasion they felt horses should prance and rear.

the same school. Praxiteles' conceptions are less lofty and dignified than those of Phidias, but they are full of grace and charm. Scopas carried further the tendency to portray dramatic moods, giving his subjects an intense impassioned expression. Lysippus returned to the athletic type of Polyclitus, but made his figures lighter and more slender, combining manly beauty and strength. He was at the height of his fame in the time of Alexander the Great, who, it is said, desired that Lysippus only should portray him. How far this age had advanced in the expression of graceful motion through the modeling of the figure and the skilful handling of the drapery can be seen in the celebrated 'Winged Victory' of Samothrace, now in the Louvre.

THE YOUNG AUGUSTUS

A fine example of Roman portrait sculpture

As time went on, Greek art lost much of its simplicity and ideal perfection of form, its serenity and restraint, but it gained in intensity of feeling, in expressing physical suffering and anguish. It had also become more realistic, portraying not only ideal types of men and gods but portraits of individuals, and not only Greeks but barbarians as well. One of the most famous works of the period after the death of Alexander is the 'Dying Gaul' sometimes called the 'Dying Gladiator'. In the 'Laocoön' group, which depicts the father and his sons crushed to death by deadly serpents, we find the extremity of physical torture as represented in sculpture. To this period belongs also the famous 'Apollo Belvedere', a statue of very great beauty, though it has lost something of the vigor and the calm power of the more heroic days. (*See* illustration on page 156.)

The Art of the Romans

From early times the Romans had felt the artistic influence of Greece, and when in 146 B.C. Greece was finally conquered by Rome, Greek art became inseparably interwoven with that of Rome. "Greece, conquered, led her conqueror captive"—this is the poet's way of expressing the triumph of Greek over Roman culture. But it is a mistake to suppose that the Romans were merely imitators, or that Roman art was merely a decayed form into which Greek art had fallen.

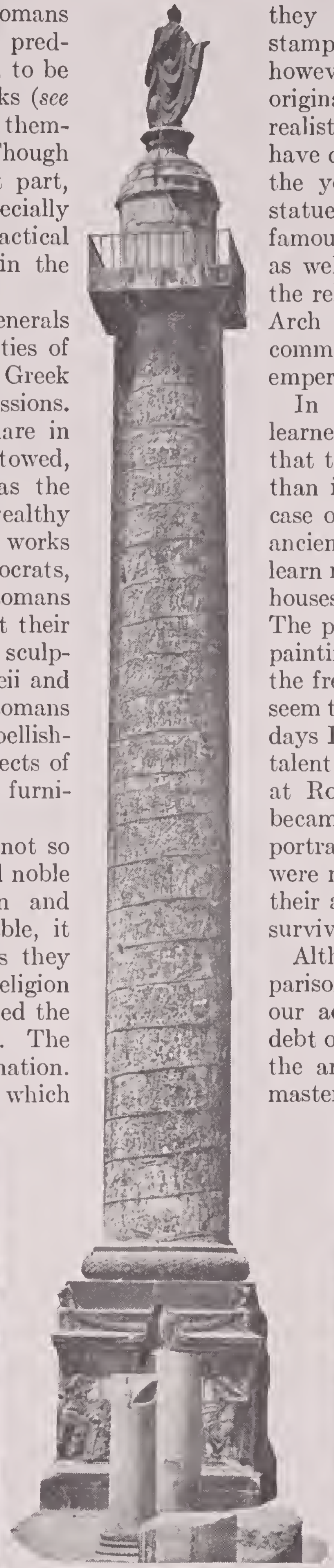
To a large extent the art of the Romans was a development of that of their predecessors in Italy, the Etruscans, who, to be sure, had learned much from the Greeks (*see* Etruscans). Nor were the Romans themselves entirely without originality. Though their artistic forms were, for the most part, borrowed, they expressed in them, especially in their architecture, their own practical dominating spirit, as you may read in the article on Architecture.

In the 2d century B.C. the Roman generals began a systematic plunder of the cities of Greece, bringing back thousands of Greek statues to grace their triumphal processions. Greek artists flocked to Rome to share in the patronage that was so lavishly bestowed, owing to the rich conquests made as the Roman power was extended. The wealthy Romans built villas, filled them with works of art in the manner of our modern plutocrats, and called for Greek artists or Romans inspired by Greek traditions to paint their walls and decorate their courts with sculptures. The ruins excavated at Pompeii and Herculaneum show us how fond the Romans and their neighbors in Italy were of embellishing not only their houses, but the objects of daily use, such as household utensils, furniture, etc. (*see* Pompeii).

But with the Romans art was used not so much for the expression of great and noble ideas and emotions as for decoration and ostentation. As art became fashionable, it lost much of its spiritual quality. As they borrowed many elements of their religion from the Greeks, so the Romans copied the statues of Greek gods and goddesses. The Romans were lacking in great imagination. Even in one of the few ideal types which they originated, the 'Antinoüs', the Greek stamp is unmistakable. In one respect, however, the Roman sculptors did show originality; they produced many vigorous realistic portrait statues. Among those that have come down to us are a beautiful bust of the young Augustus, a splendid full-length statue of the same emperor, and busts of other famous statesmen. All these have a historic as well as an artistic value. So, too, have the reliefs which adorn such structures as the Arch of Titus and the Column of Trajan, commemorating great events in these emperors' reigns.

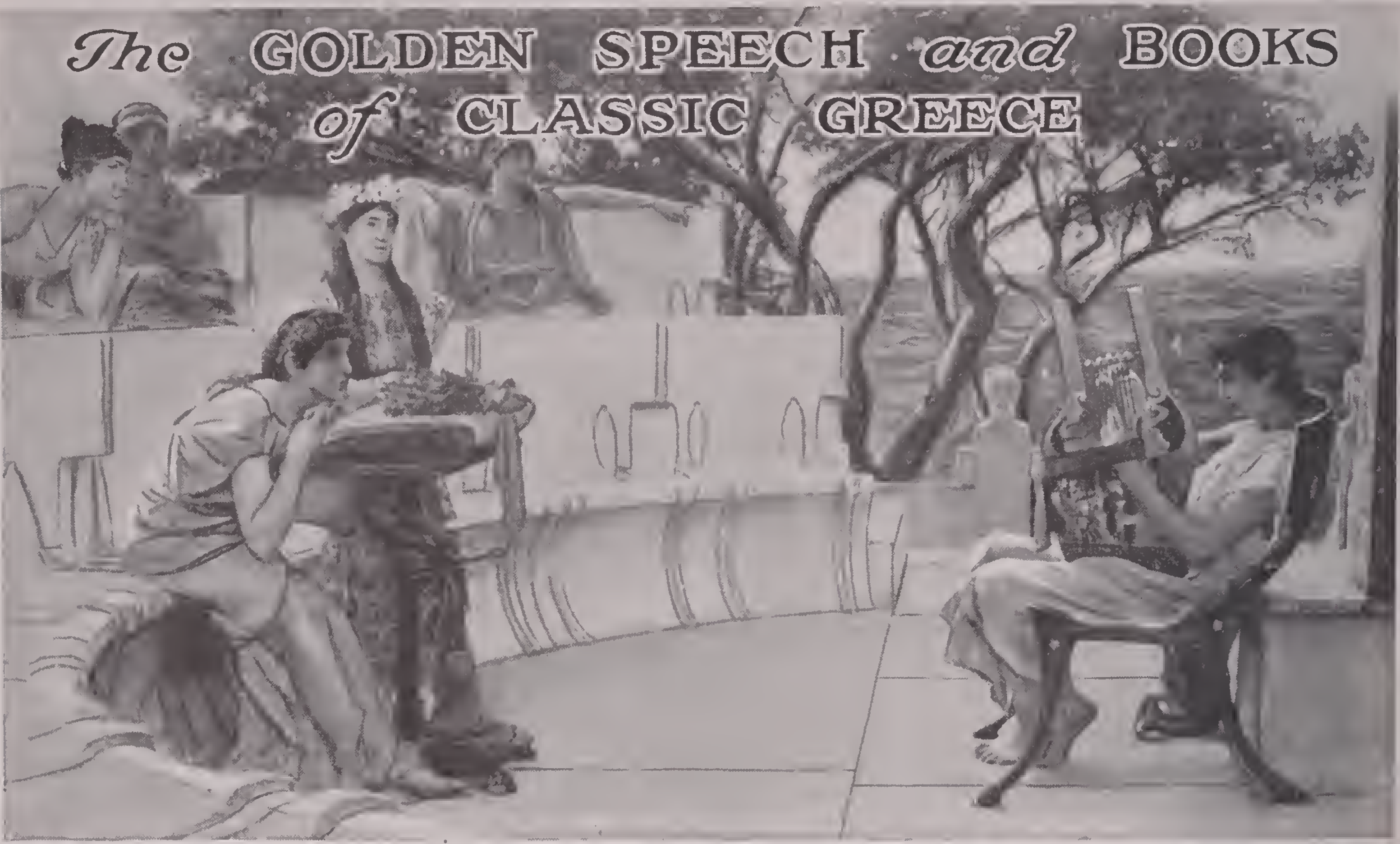
In painting—though here, too, they learned from the Greeks—it seems probable that the Romans developed more originality than in sculpture. Unfortunately, as in the case of the Greeks, the great masterpieces of ancient painting no longer exist; but we can learn much from the mural paintings found in houses at Pompeii, Herculaneum, and Rome. The pleasing coloring, which in many of the paintings still remains fresh and vivid, and the freedom and vigor of the drawing, would seem to indicate that even from these ancient days Italy was the home of painters of great talent. Portrait painting especially flourished at Rome, where hack street-corner artists became so common that one could have his portrait painted for a few cents. These were more remarkable for their realistic than their artistic merit, as we know from several surviving examples.

Although the art of Rome loses in comparison with that of Greece, still it commands our admiration, and we owe the Romans a debt of gratitude for helping to transmit to us the art of the Greeks, who were their great masters.



Trajan's Column is at once a sublime expression of Roman Art and of the dominating force of the conquerors of the World. If you should go to Rome one of these days, you will see it towering into the air nearly a hundred feet high. Running around the shaft spirally in 23 tiers are some 25,000 figures done in relief. They represent the victories of the emperor Trajan. Portions of this relief are shown on each side of our picture. Under this column, in a golden urn, the ashes of the Emperor were buried. On the summit there was originally a colossal bronze statue of him, which Pope Sixtus V replaced with the figure of St. Peter.

The GOLDEN SPEECH and BOOKS of CLASSIC GREECE



Typical of the spirit of Greece is this painting, by Alma Tadema, showing the poet Sappho, seated at the left, listening to the music of a lyre. The beauty of the fragments which we have of her work fully justifies the esteem in which the Greeks held her.

GREEK LANGUAGE AND LITERATURE. If Solon and Pericles could wander back from the Elysian Fields and sit down in some café of modern Athens they would probably be surprised to find how easily they could read the morning paper. Of course, it would take them a minute to focus their eyes on the print, so much smaller than anything done with the reed pen of their day, and they would find the shape of some of the letters changed or standardized. They would find many new words, and perhaps they would accuse the journalist of careless grammar. But all the same the literary Greek of today is perfectly intelligible to anyone who knows his Greek of 2,500 years ago. Their greatest trouble would be in ordering breakfast and talking with people about them. For many words concerning the intimate things of daily life were borrowed during medieval and modern times from the Italians, Turks, or other neighbors, and the pronunciation is so changed as to make modern spoken Greek almost unintelligible to one acquainted with only the classical tongue.

Greek nevertheless should be considered not as a dead language but as a living one. The Greek schoolboy can read the literary masterpieces of 2,500 years ago far more easily than we can read Chaucer. And the Greek language is living not only among modern Greeks, but in the up-to-date speech of America and the rest of the world. When we want to make a new word for a new thing we are likely to borrow from the Greek. For example, "osteopathy," "phonograph," "telegraph," "telephone," "automobile," "periscope," "photograph," and scores of other words that have found their way into our dictionaries to name modern inventions and developments of science are formed directly from old Greek words. Nor are we indebted to Greek only for these "made" words. Many are also woven into the very warp and woof of our language, as is told in the article on English Language. So, if you know Greek, you can often see at a glance the meaning and pronunciation of a word that would otherwise make you gasp—"anthropomorphic," for instance, which comes from the Greek words for "man" and "form," meaning therefore "man-formed" or "manlike."

But even if Greek were as dead as Sanskrit from the viewpoint of modern life, still it would be worth while for us to study it. For of all the languages of the world, the most beautiful is Greek as it was written 20 centuries or more ago. It was graceful and harmonious, full of light and shade and color, subtlety and music. It could pile words together into compounds with as great abandon as German does nowadays—only the words were prettier to begin with—or it could sail along with little words like a lightly moving skiff.

Moreover in this superb tongue was written one of the most wonderful literatures of all time. Of this literature we can only get half an idea even through the most careful translations. Poetry is always hard to translate, but Greek poetry loses more than perhaps any other, since English often takes two or three times as many words to say the same thing. A prose translation of Homer is therefore clumsy, and a translation in English verse is inadequate. Neither gives any idea of the simplicity and resonance and movement, the inevitability which never becomes monotony. The lyrics are even harder to translate, though Swinburne and Tennyson have produced free renderings of great beauty which give the English reader some notion of the qualities of the originals.

A SCENE FROM GREEK TRAGEDY

This painting by a modern German artist interprets a moving scene in the play 'Oedipus at Colonus', written by that mighty tragic poet, Sophocles. The blind old Oedipus, formerly king of Thebes, but now a wanderer on the face of the earth, has just addressed to his daughter Antigone the opening line of the tragedy, "Child of a blind old man, Antigone, what country reach we?"

Greek prose also loses much by translation, for Greek is a so much subtler instrument of expression than English that you would need a footnote to almost every word of a translation to explain the exact shade of meaning that your Greek author intended. The Greek "particles", for instance, little words only a letter or two long and amounting only to a slight gesture of the hand or the flicker of expression on a person's face, must be translated in English by some such awkward word as "moreover." A translation makes things tedious where the Greek expresses them compactly. This of course is because Greek is a rather highly "inflected" language. A single word of perhaps no more than two syllables, in Greek, may become a whole sentence with us.

The oldest Greek literary works that we have are the 'Iliad' and the 'Odyssey' of Homer, which the world still acknowledges as the most splendid examples of epic or narrative poetry. People used to wonder how first poems could be so perfect and so great as the 'Iliad' and the 'Odyssey'. The explanation is of course that these were not the first poems. They come from an age that was already rich in "folk" poetry—hymns to the gods and marriage hymns and lays telling the deeds of ancient heroes. In that age, however, the Greeks had no writing and of all the songs that the wandering bards carried from city to city and recited from memory, only the Homeric poems survived to be written down. The only exceptions are a few of the so-called Homeric hymns—the invocations to Apollo or some other god, with which it was customary for the singer to prelude his recitation of the Homeric stories themselves. The article on Homer tells you about these thrilling tales of adventure and also indicates where in these volumes you may find some of these stories retold.

From a slightly later period we have the poems attributed to Hesiod. Hesiod is a much more definite figure than Homer. He lived at the wretched hamlet of Ascra near Mount Helicon in Boeotia, probably in the 8th century B.C., and drew many faithful pictures of the dull poverty-stricken country life he knew so well. Homer and Hesiod together made a sort of bible for the Greeks—Homer telling the story of the heroic past, and Hesiod dealing with the practical realities of daily life, setting forth homely maxims and precepts for the farmer in his 'Works and Days', and in the 'Theogony' piecing together the old legends to form a systematic account of creation and the gods.

With the 8th and 7th centuries we come to the beginnings of the historical period. The old ways of life were giving way to new. Commerce, discovery, colonization, political change, widened the horizon of the Greeks and quickened their feeling and imagination. To express the thoughts and feelings aroused by this fuller and more interesting life, new literary forms were invented—all still in verse, however, for prose had not begun to be used as a literary medium. Instead of the rapid flowing "hexameter" (a line of six measures), so well adapted for narration, the poets of the 8th and 7th centuries used the meter called "elegaic," which lent itself to direct self-expression on almost any theme—patriotism, war, mourning, or political reflection—and the "iambic" meter, which was especially adapted to pointed personal utterance, usually of a satirical nature. With these forms are associated such names as Archilochus, Mimnermus, and Solon, the great lawgiver of Athens.

More varied, flexible, and complex than these forms of verse was the type which the Greeks called "melic" and we call "lyric," because it was sung to the accompaniment of the lyre or the flute. With a free rhythmic structure, capable of the most subtle variation, Greek lyric reached a degree of artistic perfection never surpassed. Religious and processional hymns, odes of victory, dirges, wedding songs, drinking songs, love poems, were poured out by artists of exquisite skill, most of whom are known to us only by fragments. Greatest of them all was Pindar (518–446?), whose magnificent odes yield the scholar a pleasure which alone is enough to recompense for the labor of learning the Greek language. Sappho, who wrote about a century before Pindar, is generally esteemed as the greatest of all women poets. Her "every word," a famous critic says, "has a peculiar and unmistakable perfume, a seal of absolute perfection, and inimitable grace."

> *"TO Greece we owe the love of Science, the love of Art, the love of Freedom. The Greek genius is the European genius in its first and brightest bloom. From a vivifying contact with the Greek spirit Europe derived that new and mighty impulse which we call Progress. If we reckon up our secular possessions, the wealth and heritage of the past, the larger share may be traced back to Greece."—S. H. Butcher.*
>
> *"The Greeks, we should never forget, were the first people to show the world what real freedom and real civilization were. And they brought, not only Politics, but Art and Science and Literature of every kind to a higher pitch than any other people ever did without borrowing from others."—E. A. Freeman.*
>
> *"The thoughts of the great Greek thinkers have been bearing fruit in the world ever since they were first uttered. In some special sciences, the work done by the Greeks remains a basis of study to this day. In Greek literature we have the fountain-head of all Western literature."—R. C. Jebb.*

As the Greeks invented the epic and lyric forms, and brought them to a perfection which has never been surpassed, so too they invented the drama (considered as a literary form) and produced the masterpieces which are still reckoned as the drama's crowning achievements. In the crowded glorious age which followed the repulse of Persia (490–479), the awakened national consciousness of Athens found expression in a series of superb tragedies which have never been equaled except perhaps by a few of Shakespeare's. The story of how the simple choral songs and dialogues performed at the festivals of the god Dionysus flowered into the majestic tragedies of Aeschylus, Sophocles, and Euripides, and how each made improvements in the dramatic form, is told in the article on Drama.

The religious character which was impressed on Greek drama by its origin was never lost. It was acted only at the festivals held in honor of Dionysus, and wealthy citizens were chosen to bear the expense of costuming and training the chorus as a public and religious duty. Attendance at the performances was an act of religious worship, and in the time of Pericles the state itself gave poor citizens the price of admission to the great open-air Theater of Dionysus (*see* Theater) that none might be debarred by poverty. All the greatest poets of the day competed for the prizes which were offered for the best plays.

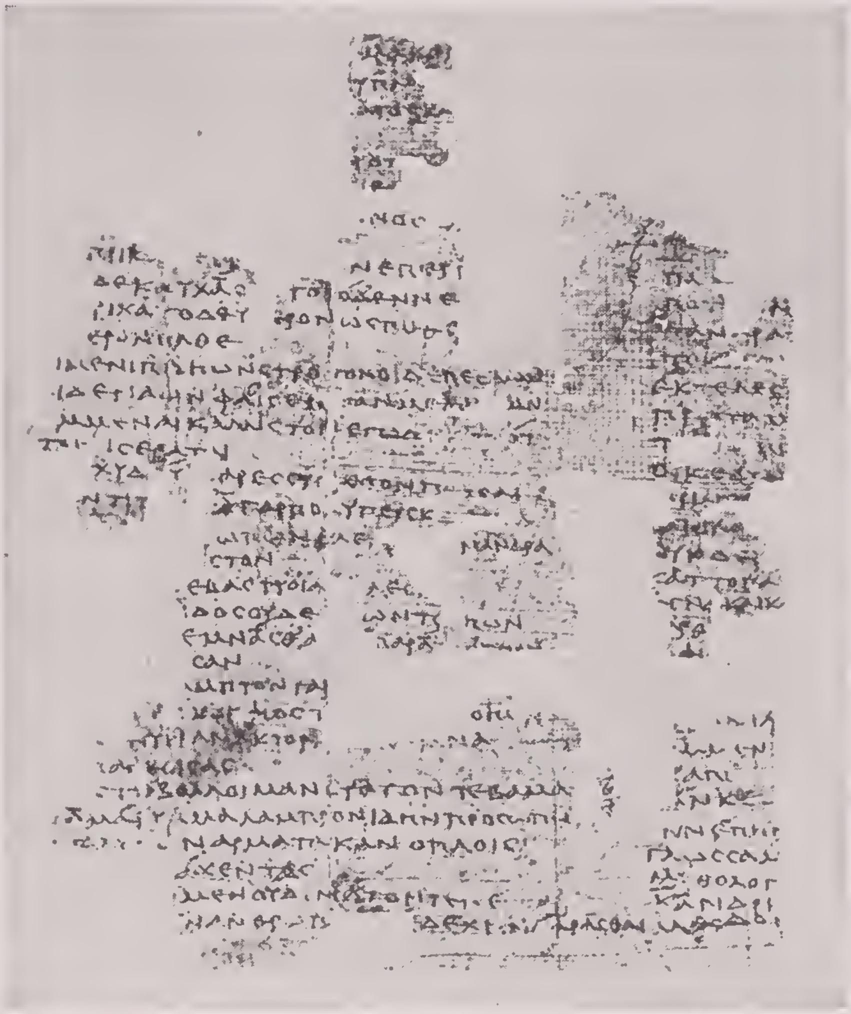
The earliest of the three great Attic writers of tragedy was Aeschylus, who was born in 525 B.C. and was present at the battles of Marathon and Salamis. He wrote between 70 and 90 plays, of which 7 remain. Many of his dramas were arranged as "trilogies," that is, groups of three related plays. The 'Oresteia' (story of Orestes), consisting of the 'Agamemnon', 'Choëphori', and 'Eumenides', is the only trilogy that has survived from ancient times. The 'Persae' is a song of triumph for the defeat of the Persians. The 'Prometheus Bound' is a colossal rendering of the legend of the superhuman benefactor who stole fire from heaven for men (*see* Prometheus). For rugged power, sublimity of idea, and ethical grandeur Aeschylus stands without a peer.

For some 16 years, between 484 and 468, Aeschylus carried off prize after prize, but in 468 his place as the favorite poet of Athens was taken by a man some 30 years younger, Sophocles of Colonus (496–406 B.C.). Sophocles' long life covered practically the whole period of Athens' greatest glory. He won more than 20 victories at the Dionysia, and produced more than 100 plays, 7 of which are extant. Sophocles "saw life steadily, and saw it whole." This serenity of attitude together with the supreme skill with which his dramas were constructed, the beauty of his language and the nobility of his characters, give us a sense of majesty and harmony such as we find nowhere else in literature. He was the most Greek of all the Greek poets. His plays have been compared to the Parthenon for their power, self-restraint, and symmetry. The 'Antigone', which is perhaps the most celebrated drama in Greek literature, is typical of Sophocles' work. Its heroine is a model of womanly self-sacrifice, and underlying the whole tragedy is the sublime idea of a higher unseen law ruling the destinies of men. Others of his plays are 'Ajax', 'Oedipus Tyrannus', 'Electra', and 'Oedipus at Colonus'.

The third of the great tragic writers is Euripides (480–406 B.C.), who was born on the island of Salamis

—so the story goes—the day of the famous battle against the Persians. Although he presented his first play at 25, he did not take the prize until he was 39, and won it only five times in all in spite of his 92 produced plays. The reason for this is that he was a modern among the ancients. He questioned the popular idea of religion, and he drew real men and women instead of gods or demigods, or idealized human beings of heroic stature. For this reason Aristotle calls him "the most tragic" of the poets, for his plays, being the most human, were also the most moving. The conservatives of his own generation did not approve of him, but in later times he was exalted to a place with Aeschylus and Sophocles. His plays are more often performed on the modern stage than those of any other Greek poet. Eighteen plays have survived, including 'Alcestis', 'Medea', 'Hippolytus', the 'Trojan Women', 'Orestes', 'Electra', 'Iphigenia at Aulis', and the 'Bacchae'.

A FRAGMENT OF SAPPHO'S POETRY



Very little of Sappho's poetry has come down to us. The character of her work is known largely through brief quotations from her poems found in the writings of other authors. Three fragments written on Egyptian papyri have been discovered in recent years, one of which is here reproduced.

From Greek comedy only the plays of one man have survived—those of Aristophanes (about 448–385 B.C.), who was for 40 years "the great burlesque critic of Athenian life." His comedies are gay fun-making about the things of his own day, always from the standpoint of the conservative. He ridicules the new learning, in the person of Socrates, and savagely lashes Euripides, who stood for the inquiring innovating attitude that he particularly hated. Socialism, women's rights, the Peloponnesian War, the fondness of the poorer citizens for serving on juries now that Cleon had raised their pay to ten cents a day—these and other aspects of current Athenian life served as subjects for his stinging sarcasm and boisterous humor. Eleven of his plays survive, including the 'Knights', 'Clouds', 'Wasps', 'Frogs', 'Ecclesiazusae' (Women in Parliament), and 'Birds'.

As always in literary history, Greek prose was late in developing. In the 6th century some of the early philosophers formulated their ideas in brief sententious prose maxims, but the first truly literary use of prose is in the 'History' of Herodotus, written about the middle of the 5th century (*see* Herodotus). The theme of Herodotus is the struggle between East and West, culminating in the Persian Wars. His great successor Thucydides (about 471–396) told the story of the Peloponnesian Wars. Thucydides' critical use of sources, his inclusion of documents, his laborious research into the roots of events, make him the most modern of the Greek historians—"the first philosopher of history"—far removed from the romantic inclusiveness of Herodotus or of Xenophon (*see* Xenophon).

The 5th century also saw the rise of another prose art, the art of oratory, with its companion art of rhetoric, which taught the technique of making successful speeches. With the establishment of democracy in Athens and other Greek cities, the ability to make convincing speeches before the popular assemblies, and especially in the law courts, became of the greatest practical value. Litigants were usually compelled to plead their own cases, instead of hiring others to plead for them; so rhetoric became part of the ordinary education of the youth, and a new profession arose—that of the writer of speeches for men to speak in their own behalf. A large proportion of the speeches of the Attic orators that have come down to us were meant to be used in this way. The 4th century was the golden age of oratory, made memorable by the polished and artful speeches of Lysias, Isocrates, Aeschines, and the master orator of all time, Demosthenes (*see* Demosthenes).

The same lively curiosity and insatiable interest in the spectacle of the universe which led the Greeks to invent epic and lyric verse, drama and history, also made them the first philosophers. Their craving to find a reasoned answer to the riddles of life resulted in the creation of another department of prose literature, represented chiefly by the great names of Plato and Aristotle. Beginning with the 6th century, one thinker after another advanced his theory of the material causes of the universe, of knowledge, and of conduct. Many of the fragments of their teachings which have been preserved in the form of terse epigrammatic statements in prose or verse seem crude and childish to us today, but they serve to remind us how long and toilsome is the road that leads to wisdom. (*See* Pythagoras.) The first thinker to lay a really scientific basis for philosophical inquiry was Socrates (469–399 B.C.), whose tireless questioning into the roots of conduct and searching criticism of all traditional doctrines so outraged the orthodox and narrow-minded that he was put to death (*see* Socrates). He wrote nothing himself, but his great pupil Plato (427–347) perpetuated and developed his teaching in a matchless series of dialogues, packed with fresh and stimulating ideas which have inspired every philosophical thinker since his day (*see* Plato). Third of the immortal trio of Athenian thinkers was Plato's pupil, Aristotle, the father of science. Aristotle sought to map out nearly the whole field of human knowledge into the various sciences, laying a foundation for all later scientific inquiry. In the history of literature, his work cannot rank with the superbly artistic Platonic dialogues, but in the history of thought he is acknowledged as "the master of those who know." (*See* Aristotle.) Theophrastus, who succeeded Aristotle as head of the school called the Lyceum, is chiefly remembered for a series of lively character sketches which have found imitators in every age.

With these names the story of classical Greek literature ends, but the Hellenistic age in Alexandria offers us a second rich library (*see* Alexandria, Egypt). The name that stands out in poetry is that of Theocritus, who wrote exquisite little shepherd dialogues picturing the rural life of his native Sicily. Imitators from Vergil to our own day have tried in vain to recapture the freshness and charm of the pastoral form as Theocritus first used it. Other poets of this age are the lyric poet Callimachus; Bion and Moschus, writers of pastoral verse; and Apollonius Rhodius who wrote the Argonautica, an epic in four books on the quest of the Golden Fleece. Greek prose, too, continued to flourish far into Roman times, and from these later days we have our first forerunners of the novels (*see* Novel), as well as important works of geography and history.

The most noteworthy of these later writers are the historians Polybius, Diodorus Siculus, Josephus, and Appian; the geographers Strabo and Pausanias; the biographer Plutarch, who has given us more general information about antiquity than any other single writer (*see* Plutarch); the critic Longinus, to whom is assigned one of the best of all works of literary criticism, the treatise 'On the Sublime'; the humorist Lucian, whose 'Dialogues of the Gods' are almost as outrageously laughable as a comedy of Aristophanes; and the two Stoic philosophers Epictetus and Marcus Aurelius, one a slave and the other an emperor (*see* Epictetus; Marcus Aurelius Antoninus).

In various localities the Greek language was spoken and written with variations sufficiently great to cause three chief dialects to be recognized, though the differences were never so great as to cause difficulty of communication. The Ionic dialect, the language of Homer and Hesiod, was spoken in most of the Aegean islands and on the west coast of Asia Minor. With a few modifications, the Ionic is identical with the Attic, the principal literary dialect, used in the works of the great Attic writers. The Doric, the language of Pindar and Theocritus, was spoken at Corinth and throughout most of the Peloponnesus. The Aeolic, in which Sappho wrote, was spoken in Boeotia, Thessaly, and Aeolis (northern Asia Minor).

In modern Greece there is a sharp cleavage between the dialect of the people, called "Romaic," and the literary language, which represents an attempt to return so far as possible to the standards of classical Greek. The struggle between the "purists" and the adherents of the popular tongue is still waged with so great bitterness that in 1901, 20 persons were killed or injured in a mass meeting of protest against the proposed issue of a translation of the Gospel into Romaic. The style of most current literature and journalism represents a compromise between these two ideals, but the most powerful poetry and fiction are written in the "vulgar" tongue.

GREELEY, HORACE (1811–1872). If it is true that "the pen is mightier than the sword," then Horace Greeley, the newspaper man, might possibly be considered greater than Grant and Lee or any other general of the Civil War. Not only was he the greatest molder of public opinion in the period preceding and during the war, but he was probably the greatest journalist America has ever produced. Because of the importance of his work the poet Whittier called him "our later Franklin."

Greeley was, in his own words, "born in poverty, cradled in obscurity, and early called from school to rugged labor," but he sought "to convert obstacles into opportunity, and wrest achievement from difficulty," and his efforts were successful.

Born in New Hampshire, he learned the printing trade in Vermont, and later joined his parents in western Pennsylvania. In 1831 he went to New York with $10 in his pocket and his clothes in a bundle carried over his shoulder. After several newspaper ventures which brought him much notoriety but little money, he started the *New York Tribune*, as a Whig daily, in 1841.

The success of this paper was immediate, and its circulation soon covered the country from the Atlantic to the frontier of Missouri. In its columns Greeley opposed slavery, advocated a high protective tariff, and aided the temperance movement. At the outbreak of the Civil War he urged the government to refrain from "pinning one section to another by bayonets." Afterwards he was an earnest upholder of the government, and he urged the emancipation of the slaves even before Lincoln was ready for that step.

After the war was over Greeley wished the country to treat the South leniently. To set an example, he signed the bond by which Jefferson Davis was given his freedom. He could not carry the country with him in this attitude, however; and in 1872, when he was the candidate of the Liberal Republicans and the Democrats against Grant, he was disastrously defeated. Borne down by political and domestic misfortune, he fell ill, and died Nov. 29, 1872.

In spite of the success of the *Tribune* and the large sum Greeley made on the lecture platform, he was never wealthy, because he always aided everyone who asked him for help, both the worthy and the unworthy. He was extremely simple in his habits and careless in his dress. His handwriting was so poor that it was the despair of type-setters on the newspapers, who declared that it resembled nothing so much as the muddy tracks a hen would make walking over a piece of white paper. For brilliancy of mind and high moral courage, he was unsurpassed among the men of his day.

GREENE, NATHANAEL (1742–1786). By common consent the brilliant general Nathanael Greene is regarded as a military leader second to Washington alone in the American Revolution. His father was a blacksmith in Potowomut, R.I., but a Quaker preacher on Sundays, and trained his son in the strict principles of that sect. When the quarrel between the colonies and England was growing hot, Greene joined the militia, and studied military tactics. For this martial zeal he was excommunicated by the Friends' Church. His military training won him a brigadier-generalship and the command of the Rhode Island forces in 1775. He marched his troops to Cambridge after the skirmishes at Lexington and Concord and welcomed Washington as the new commander-in-chief in July 1775.

Greene speedily won the friendship and confidence of Washington, under whom he served with distinction at Trenton, Princeton, and Brandywine. At Washington's request he accepted at Valley Forge, in March 1778, the difficult position of quartermaster-general, retaining, however, the right to command troops in the field. Because of the meddling of Congress with the affairs of his department Greene resigned his position in 1780, but was shortly afterwards appointed by Washington as commander of the Army of the South.

When Greene succeeded Gates in this command, he found the army in so wretched a state, without discipline, arms, or clothing, that he could not bring it into condition for fighting until 1781. As soon as this had been accomplished, he began a campaign which in less than a year stripped the English of all their conquests in the Carolinas and Georgia except Charleston, in which he penned up the British army for the rest of the war. For this he received the thanks of Congress, large grants of land from the Carolinas and Georgia, and the name of "the man who saved the South" in the American Revolution.

CHILDREN OF THE LAND OF SNOW

Whatever other people think of the climate of Greenland, it is easy to see that it just suits little Shoo-e-ging-wah and Megipsoo.

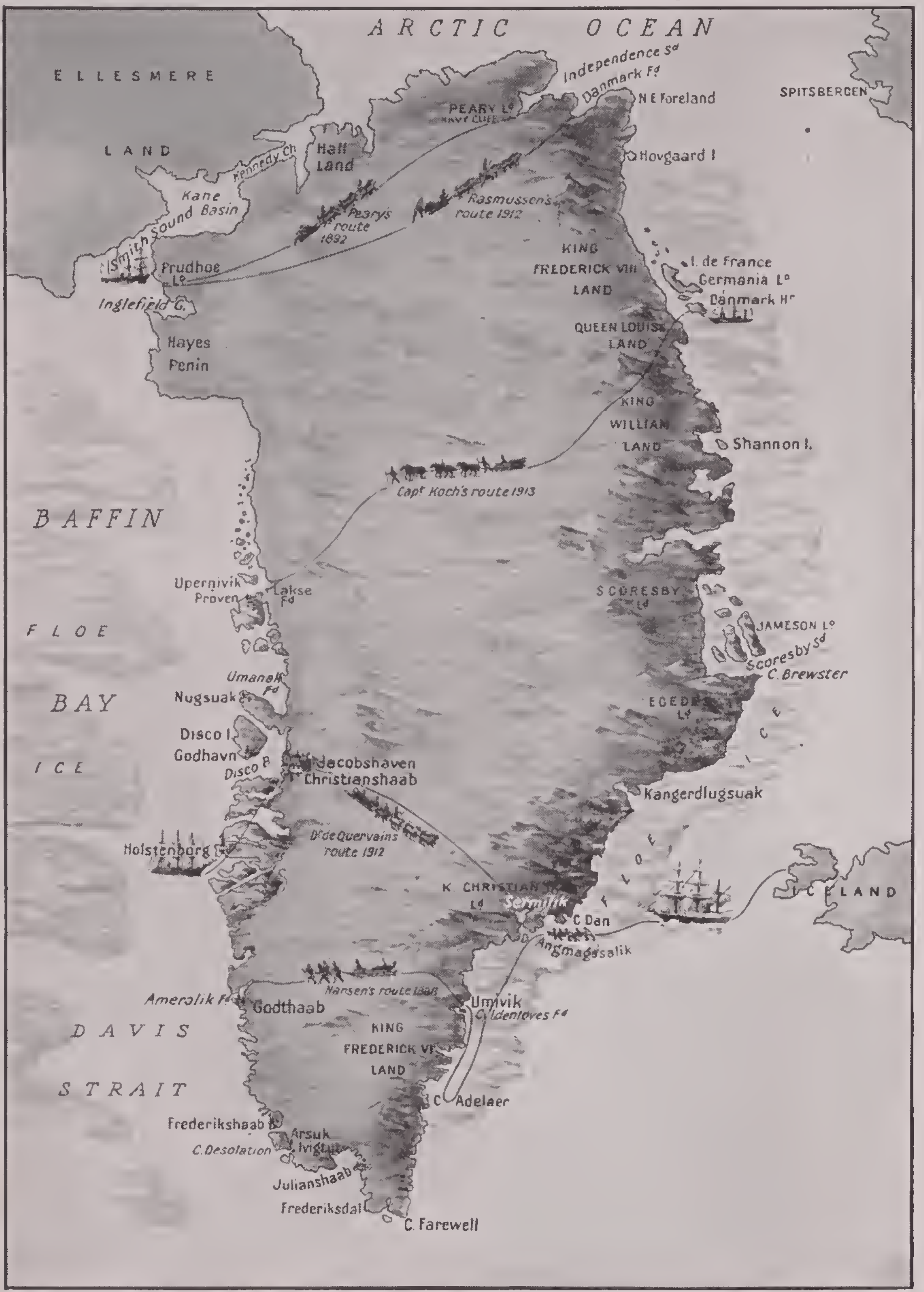
GREENLAND FASHIONS

Here we see a Greenland belle dressed in her finest party clothes.

GREENLAND. The snows of countless centuries have woven an impenetrable winding-sheet of ice thousands of feet deep over more than three-fourths of the surface of this immense continental island, which lies to the northeast of America and almost wholly within the Arctic Circle. Its narrow rocky shores are fringed with ancient worn-down mountains (some more than 10,000 feet high) and deeply cut by innumerable fiords and valleys. Only a few hardy explorers have crossed the ice-capped interior, so its topography is imperfectly known. It is certain, however, that it is the largest island in the world, estimates of its area ranging from 512,000 square miles to 825,000, while New Guinea, the second largest island, has only about 300,000 square miles. Greenland's length is about 1,600 miles and its breadth from 800 to 900 miles.

Denmark exercises authority over the entire island, but only 46,740 square miles are under settled government. The east coast is uninhabitable because of a cold current, but the west coast is warm enough to permit the growth of a narrow belt of green tundra. Life in this arctic wilderness is a simple isolated one for its inhabitants, the hardy Eskimo and the few hundred Danes and half-breeds, who live with their dog-sledges and *kayaks* (sealskin covered boats) in the stone or snow-hut settlements along the coast. In the uncertain climate of fogs and snows and icy winds (bitterly cold in the sunless north, but down in the southwest often mild enough to breed mosquitoes), these people live an out-of-door life hunting seals,

THE GIANT ISLAND OF ICE AND SNOW



The man who named Greenland must have had a fine sense of humor. The west coast, to be sure, has a narrow belt of green, and no doubt was looking particularly attractive to Eric the Red when he landed there back in the 10th century. But for the most part its surface is just one enormous glacier. We see here the course of bold explorers who have crossed this vast region, where the temperature sometimes reaches 90° below zero.

whales, walrus, bear, or fox, and fishing for salmon, cod, and halibut. Their commerce is a Danish monopoly and their trade is carried on chiefly by the barter of their principal exports—whale and seal oil, eiderdown, and skins. They also mine and export cryolite in large quantities. This is a light brilliant mineral used in making soap, soda salts, aluminum, and a fine quality of glass, and the mining rights are held by Americans under a Danish charter. Coal, copper, and iron have also been discovered. A considerable native literature has been published, including a periodical written and illustrated by Eskimos.

From "Greenland's icy mountains" comes the dangerous glacier sheet that flows under pressure of its own weight, discharging into the sea every year more than 1,000,000,000 tons of ice (*see* Glacier). Many of these glittering icebergs are carried down into the lanes of ocean travel, where they imperil navigation (*see* Icebergs). It has been estimated that if all Greenland's ice were spread over the United States it would make a covering a quarter of a mile thick!

Greenland was named by the Norwegian Eric the Red, who about the end of the 10th century reached its southwestern coast and founded a colony. Communication with Norway ceased in 1410 and Greenland became lost to the world until the close of the 16th century, when it was rediscovered by English explorers in search of the Northwest Passage to India. In recent years Greenland has been a favorite field for explorers. Americans from Kane to Peary have discovered, explored, and given names to nearly all its north and northwestern shores, and it has been an important stepping stone for polar exploration in the remoter north. Population, about 14,000. (*See* Eskimos.)

GREGORY, POPES. Sixteen popes—two of them among the greatest the church has produced—have borne this honored name.

GREGORY I, called the Great (lived about 540–604), was a Roman of old family and great wealth who became a monk in a Roman monastery which he himself endowed. His interest in the Roman island of Britain was aroused by seeing some beautiful English boys sold as slaves in the market place at Rome, and when he became pope in 590, he sent St. Augustine as missionary to England to convert the people from their heathenism. Gregory defended Rome against repeated attacks of the Lombards and exercised much of the power in the West which had fallen from the hands of the weak Eastern emperors. He also wrote ably on theology and composed the Gregorian chant which is still used in church services. He was one of the ablest of the popes, and after his death was made a saint.

Gregory VI (died 1047) earned a high reputation for learning and uprightness, but he was deposed by a council held by Emperor Henry III, on the ground that in a time of confusion he had obtained his office by improper means.

Gregory VII was the mighty Hildebrand (lived 1020–1085). After being the power behind the throne for a quarter of a century, under five popes, he himself was chosen pope in 1073. His pontificate is memorable for the beginning of the great Investiture Conflict with the Emperor Henry IV of Germany. His purpose was to create a sort of "league of nations" with the Pope as its head. A Catholic historian sums up Hildebrand's ideas in these words: "Seeing the world sunk in wickedness and threatened with impending ruin, and believing that the Pope alone could save it, he conceived the vast design of a universal theocracy, which should embrace every kingdom of Christendom, and of whose policy the Ten Commandments should be the fundamental principle. Over this commonwealth of nations the Pope was to preside. The spiritual power was to stand related to the temporal as the sun to the moon, imparting light and strength, without, however, destroying it or depriving princes of their sovereignty."

After a violent conflict Henry IV was obliged to humble himself, barefoot and fasting, before the Pope at Canossa (1077). But the struggle soon recommenced. Henry attacked the Pope in Rome itself; and the aid of the Norman Robert Guiscard only permitted Gregory to retire from Rome to Naples. He died at Salerno shortly after, saying: "I have loved justice and hated iniquity; therefore, I die in exile." No pope ever left a stronger impress on his time than did the fearless, upright, inflexible Gregory VII.

Gregory IX (pope 1227–1241) is chiefly memorable for his conflict with the Emperor Frederick II. Gregory XI (pope 1370–1378) was a French churchman who instituted many reforms and transferred the papacy back to Rome from Avignon, where it had been for 70 years. Gregory XII (pope 1406–1415) upheld the rights of the Roman pontiffs against the Avignonese antipope Benedict XIII, in the time of the Great Schism. Gregory XIII (pope 1572–1585) made the great reform in the calendar. Gregory XVI (pope 1831–1846) encouraged learning and founded the Egyptian and Etruscan museums in the Vatican.

GRENFELL, Sir Wilfred Thomason (1866). For generations to come, one of the favorite stories of the Labrador fisher folk will tell how this doctor brought comfort and joy and health to their desolate land. For Sir Wilfred Grenfell is an English medical missionary who for his self-sacrificing labors in the North Sea and Labrador was knighted by King Edward VII of England.

Upon his graduation from Oxford University he entered London Hospital to study medicine and surgery. He had decided to devote his life to missionary work, and he had the idea that practical help in bettering health and living conditions should go hand in hand with religious teachings. Among his patients were many seamen, for the hospital was in the Whitechapel district, a region notorious for its poverty and crime. Becoming interested in this neglected class of men, most of whom had no permanent home, he fitted up an old sailing vessel for a mission ship, and went out into the North Sea, among the tramp steamers and fishing fleets. Within a few years he built a sailor's hospital, a coöperative store, a mill, an orphanage, and a school. He attracted so much attention by his brilliant success in this unique work that Lord Strathcona, the railroad and empire builder of Canada, gave him a steel steamer to carry it further.

SIR WILFRED GRENFELL
The Doctor Missionary

From Lord Strathcona, who in his youth had been a fur buyer in the Canadian wilderness for the Hudson's Bay Company, Dr. Grenfell heard of the deplorable condition of the English, Scotch, and French-Canadian fisherfolk of Labrador. During the short summer, ministers and doctors from Newfoundland visited the fishing villages along the 3,000 miles of that wild coast; but for nine dark months of every year the people were frozen in, with no means of communication with the outside world except by dog-sledge over the treacherous ice.

In 1892, when he was 27 years old, Dr. Grenfell went to Labrador, and made that forbidding region the field of his missionary labors. Every summer since, although icebergs and floes, fogs, gales, and jutting crags make his voyages dangerous, he has cruised up and down the coast in a swift steam yacht, stopping in any harbor where a signal flag flies. In winter he travels by dog- or reindeer-sledge. He has fought epidemics of smallpox, made the villages sanitary, instructed the women in nursing, and taken the seriously ill and injured to his hospitals in Battle and Indian Harbors. He has opened a road along the coast and introduced reindeer herds for their milk and for rapid travel. He preaches on Sunday in any schoolhouse, christens the babies, marries the young, and buries the dead. His traveling library circulates books, papers, and magazines, and he has brought Santa Claus to the children.

Finding that Christmas was not being properly kept in this bleak and remote corner of the world, Dr. Grenfell made a public appeal for gifts. Great boxes arrive in Battle Harbor in the summer, and at Christmas there is a decorated tree in every village church, and a Santa Claus who dashes up in a gay red cutter, with prancing reindeer. In all the world there is not a more beautiful or helpful mission than that of this doctor-knight of Labrador.

Dr. Grenfell is the author of the following books related to his work: 'Off the Rocks' (1906); 'Adrift on an Icepan' (1909); 'Labrador, The Country and Its People' (1909). Norman Duncan, who knows him and his work intimately, has written 'Dr. Grenfell and his Parish' and two volumes of fiction based on his devoted service and heroic experiences.

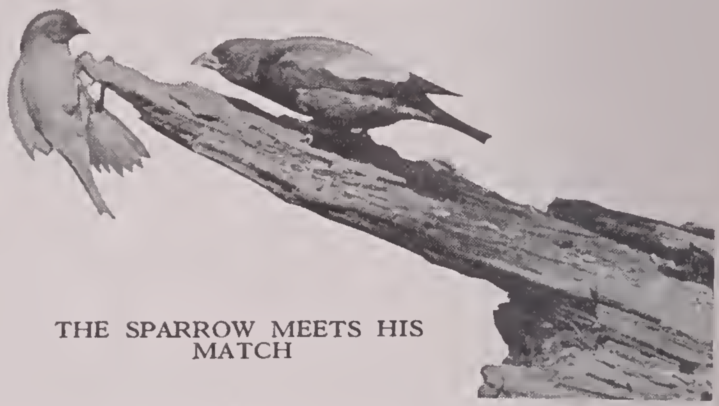
GREY, LADY JANE (1537–1554). This sweet-souled and innocent child, the "nine-days' queen" of English history, was sacrificed to the self-seeking ambition of shameless intriguers. By the will of her great-uncle, Henry VIII, she had been placed next after his daughters Mary and Elizabeth in the line of succession to the throne. It was thought possible to discredit Mary and Elizabeth as illegitimate, and thus make Lady Jane heir to the throne after the sickly Edward VI. With this purpose in mind the unscrupulous Duke of Northumberland caused her to be married to his son Guildford Dudley; by this means he hoped to continue himself in power after Edward's death. Edward died on July 6, 1553. Lady Jane was proclaimed queen on the 10th. By the 19th the whole scheme had collapsed, Northumberland was arrested, and she too was a prisoner.

Lady Jane was never to be free again. She remained locked in the gloomy Tower of London for many months. Then an uprising against Queen Mary, in which Lady Jane's father took part, led the queen to seal Lady Jane's death warrant. She was beheaded on Tower Hill, London, on Feb. 12, 1554. In her speech from the scaffold she "washed her hands" of any desire to be queen, and said: "I die a true Christian woman." The place of her imprisonment still draws to it the feet of later generations, whose hearts have never ceased to sorrow over the hard fate of this beautiful and innocent girl.

GRIEG (*grēg*), **EDVARD HAGERUP** (1843–1907). The peculiar leaping rhythms and strange harmonics of Scandinavian folk-music were the inspiration that brought Grieg to a position among the great composers of the 19th century. He was born in Bergen, Norway, but was sent to Leipzig, Germany, for his musical education, and his early compositions give evidence of this German influence. But on his return to Norway his imagination was seized by the entrancing Norwegian folk-songs and he determined to develop the full beauty of these artless tunes by making them the basis of compositions for piano and orchestra. Thus he did for Norway what Chopin did for Poland, and Liszt for Hungary.

When Grieg was 31 years of age the Norwegian government granted him a life pension. Thus relieved from the necessity of teaching, he devoted himself entirely to composition, with occasional concert tours. As a conductor he was magnetic, and everywhere he was acclaimed as a most individual and enchanting pianist. He played only his own compositions—beautiful lyrics, tone-poems for the piano, that breathe all the exhilaration and freshness of the northland. Of his orchestral works the frequently heard 'Peer Gynt' suites are most popular. His 125 songs are hauntingly distinctive with great depth of feeling and originality in melodic and harmonic structure. The last years of Grieg's life were spent in his beautiful villa Troldhaugen, near Bergen, Norway.

GROSBEAK. "Fine feathers do not make fine birds," but often extremely fine birds have fine feathers. The rose-breasted grosbeak has beautiful black-and-white plumage with a rose-colored breast, a lovely song, a happy manner, and a clear conscience, for he knows that the few green peas and berries in his crop have been paid for many times over (for illustration in colors *see* Birds). Even though he lacked beauty, song, and manners, his appetite alone would make him invaluable to the gardener, for with his plainly feathered mate and his hungry brood he will rid a bug-infested potato patch of the pests in short order and supplement the potato-bug diet with such caterpillars as army-, canker-, and cutworms. Does he not deserve a few berries and peas?



THE SPARROW MEETS HIS MATCH

The Sparrow has earned a bad reputation by driving away so many of our song birds, but he soon learns to let the Grosbeak severely alone. Here a Grosbeak is driving a Sparrow away from a feeding log.

Quite as much can be said in favor of other grosbeaks, which is a common name for a group of the finch family with thick powerful beaks (hence the name grosbeak). All have bright-colored feathers, lovely songs, and appetites for harmful insects. The rose-breasted grosbeak is commonly spoken of as *the* grosbeak, but other species such as the pine and evening grosbeak equally deserve the name. They are from 8¼ to 9 inches long. The females of all species are quietly colored. The feeding and nesting habits are similar, except in the case of the pine grosbeak which eats no insects and feeds almost entirely on seeds of such trees as the pine, ash, and sumac. The nest of twigs and weed-stalks is built in trees. The spotted eggs are from three to five in number. The birds migrate south in winter, though the evening and the pine grosbeaks are found wintering as far north as Iowa, Illinois, and New England.

The cardinal is the most showy of the group (*see* Cardinal Bird). The home of the rose-breasted grosbeak is in the eastern half of the United States and southern parts of Canada. It winters south to Cuba and Central America. The evening grosbeak with its striking yellow and black feathers is found in Canada and occasionally during the winter flocks have been seen in the northeastern United States. The black-headed grosbeak of the Far West and Mexico has a neck and breast of tawny gold and his black wings marked with white (for illustration in colors *see* Birds). It is said that the female of this species, contrary to all mother-bird rules of caution, sings while on her nest. The blue grosbeak, a rather rare bird of the southern United States, has dark blue-gray feathers. The pine grosbeak is found in the pine-tree regions of both the Old and the New World. Its beautiful reddish-pink feathers which blend so beautifully into the gray under-plumage change, after molting, to yellow. Another common grosbeak of Europe is the hawfinch. It has a crown and back of rusty brown, gray under parts and black and white wings.

Grosbeaks belong to the family *Fringillidae*. Scientific name of rose-breasted grosbeak, *Zamelodia ludoviciana*.

GROUNDHOG GROUNDHOGS IN CLOVER

During the warm weather, the Groundhog spends most of his time in the open fields eating for all he is worth. For he does not lay by a winter supply of food, and must rely instead on the surplus fat he accumulates under his skin to keep him alive during the "sleeping season." Here we see a whole family chewing up a clover field and gaining weight with each mouthful.

GROUNDHOG. The groundhog, also called the woodchuck, is America's most famous, though not most accurate, weather prophet. Tradition insists that on February 2 of each year—"Groundhog Day"—this little animal, which has been snugly curled up in its burrow all winter, sleepily living on its own fat, emerges for a look about to see if it is time to resume its waking life. If the sun is shining so that it can see its shadow, it retires for another six weeks of slumber in its subterranean home, according to the popular legend, but if the sky is cloudy, it remains outside, anticipating an early spring.

Groundhogs are well known in the eastern states and in Canada. They like grassy hillsides and wood-pastures, especially if there is wooded country near that offers a safe retreat. Their homes are usually in the midst of a forest where their burrows are quite elaborate affairs of branching galleries. They feed on clover and succulent grasses including various cultivated crops, especially the vegetables in fields and gardens, and hence are regarded as a nuisance. They have practically no economic value. Their flesh is little esteemed and their pelts of coarse hair are worthless as fur. They do not store up food in the summer, but as the winter draws near they feed heavily and become excessively fat and when winter has come retire to their burrows and sleep until spring. Their surplus flesh is used up during this period, so that they emerge looking very thin indeed.

The groundhog or woodchuck (*Arctomys monax*) is a typical marmot, with coarse hair, heavy body, short bushy tail, and powerful legs and feet armed with strong claws. When fully grown it weighs about ten pounds. The color varies from brownish gray to almost black. When alarmed it utters a curious shrill whistle of fear.

GROUSE. The grouse is the sportsman's favorite bird, and the eagerness with which it has been hunted has almost exterminated it in some regions where it was once very abundant. Most of the 25 species found in the Northern Hemisphere are excellent eating and no less excellent sport for the hunter. It is the

Here's a Grouse's nest, snugly tucked away among the leaves and brush in the woods, and there are one, two, three — fourteen eggs! What large families those Grouse people have!

habit of these dull-plumaged birds to lie hidden in the grass until the dogs are upon them; then, with a sudden great whirring sound, and with almost the speed of an arrow, they rise before the eyes of the startled hunter, who must be both cool and quick if he is to bag his game.

WHEN MR. GROUSE GOES COURTING

Here Mr. Grouse has taken his position on a log, and the flutter of his wings is producing that "drumming" sound that is heard a mile away. That sound is his love song.

The common colors in the plumage are brown, gray, and red, with touches of purple and dark green in some species. Generally the colors of the male birds are more pronounced. The dress of the female is an excellent example of what naturalists call "protective coloration" (*see* Protective Coloration). It is so nearly the color of her surroundings that, if she remains motionless on her nest among the grass and leaves, even a keen-eyed fox or hawk will pass her by. Some members of the grouse family that live in regions where snow is common change their sober summer coats for a winter plumage as white as the snowy wastes they inhabit, and grow downy feathers on their feet that keep them from sinking into the snow. Other species grow horny appendages from the sides of the toes to serve as their snowshoes.

"SNOW GROUSE" IN THEIR WINTER CLOTHES

This is a scene in the far North, and the Ptarmigans or "Snow Grouse" have changed their summer coats of grayish brown to their winter clothes of white.

The male birds are noisy wooers. During the mating season their peculiar love-calls may be heard ringing through the woods and over the prairie lands. These calls, which take the place of the mating song of singing birds, are dull booming sounds variously produced. Some species have a most extraordinary wing power and by rapidly beating the air or their breast feathers produce a sound that may be heard a mile or more. Other species are furnished with an air sac of loose skin which acts as a sort of bagpipe, for the bird inflates it to an amazing size; then, with a jerking of the head, he forces the air from it with a hollow "boom, boom, boom," which draws the female birds of their kind. These love "songs" are accompanied by much strutting about and spreading of feathers, and by many fights among the cocks.

Grouse range in size from the small white-tailed ptarmigan 13 inches long to the sage hen 30 inches long. They eat seeds, fruits, and insects. Among all the various species, except the ptarmigans, one cock mates with a whole covey of hens. The nest is on the ground and the hen takes entire care of the 10 to 14 eggs and of the young brood.

Of the North American species the best-known is the ruffed grouse, incorrectly known in the North as the "partridge" and in the South as the "pheasant." It is found throughout southern Canada and eastern United States, west to eastern Kansas and south to northern Georgia. It is about 18 inches long and has tufts of shiny black feathers on each side of its neck, which look like a ruff and so give the bird its name. A crest of feathers adorns the top of its head. In the early days before this bird had come to know the ways of man it was so trustful and unsuspicious that it would sometimes sit quietly gazing at the traveler until it was knocked from its perch with a club. Hence the ruffed grouse, as well as other varieties showing the same tendency, came to be spoken of as "fool-hens." But once having learned the lesson of the dog and gun, the grouse became wise to an almost uncanny degree. Hunters tell of seeing a mother bird try to entice them away from her brood by crying and fluttering along the ground as if wounded; and when attacked she will defend the young with her life.

The prairie chicken (pinnated grouse) is a favorite species found in central Canada and in the central United States, though in sadly reduced numbers. It weighs about two pounds and is one of the finest wild food-birds. There is a slight crest on the head and long tufts of narrow stiff feathers grow backwards on each side of the neck. The male birds have a calling air-sac on each side, just under the neck tuft of feathers.

The sage hen is the largest of the family, coming next to the turkey in size. Its home is the barren alkali deserts, where it lives almost entirely on sage bush leaves. This gives the old birds so strong a sage flavor that they are not desirable for the table, but the young are good eating, and have been so much hunted that the species is fast being exterminated.

The ptarmigans, sometimes called "snow grouse," are smaller birds of the grouse family. They live in the arctic region of America, from Alaska to Labrador, but sometimes migrate for breeding to the northern states. In the autumn they change their summer coat of grayish brown to a winter coat of pure white. Explorers and the Indians and trappers of the North have found them a valuable food supply.

The red grouse or moorfowl is the famous grouse of the British Isles. It is so well protected by law that it is very plentiful, and sportsmen from all over the world go to Scotland every fall for the grouse-shooting.

The grouse belong to the order *Gallinae*, which also includes the common hen and quails, turkeys, and pheasants. Scientific name of ruffed grouse, *Bonasa umbellus;* prairie chicken, *Tympanuchus americanus;* sage hen, *Centrocercus urophasianus.*

GUADELOUPE (*ḡa̤-dĕ-lo̤p'*). About 75 miles north of Martinique, in the French West Indies, lie the twin islands of Guadeloupe, which with five nearby islets constitute the largest colony of the French in this region (area, 688 square miles). A narrow strait divides the two main islands, one of which is crowned by lofty mountains, while the other is a low plain. The products are chiefly sugar, coffee, vanilla, cocoa, and rum. Terrible damage is often done by earthquakes and by the terrible hurricanes which sweep the Caribbean Sea. The capital is Basse-Terre (9,000 inhabitants), but Pointe-à-Pitre (23,000 inhabitants) is the chief town and harbor.

Gaudeloupe was discovered by Columbus in 1493. Except for three short intervals when it was held by the British, it has been French since 1634. It is administered by a governor and general council, and is represented in the French Parliament by a senator and two deputies. Population, about 215,000, chiefly negroes and mulattoes.

GUAM (*ḡwäm*). The first of the South Sea Islands to feel the touch of a white man's foot was Guam, now the possession of the United States; for Ferdinand Magellan landed on Guam, the southernmost of the Marianas group, on March 6, 1521. When the natives stole one of his small boats, Magellan burned the houses along the beach and killed eight of the inhabitants. Guam and the neighboring isles were called the "Ladrones" or "Thieves Islands" by Magellan's crew; but later the name was changed to the Marianas.

The importance of Guam today is due to the fact that it is a United States naval station, one of the landing-places of the submarine cable running from San Francisco to Manila in the Philippines, and a wireless telegraph station. Guam, together with the other islands of the Marianas group, was seized by the United States during the Spanish-American War in 1898. After the war Spain was allowed to keep the neighboring islands, and in 1899 sold them to Germany; with the downfall of Germany in the World War they passed to Japan under a mandate from the League of Nations.

Guam is about 32 miles long and from 4 to 10 miles wide. Most of the island is a pathless jungle, inhabited by native rats, flying foxes, and bats, and by imported deer, wild goats, and wild pigs. European cattle and water buffaloes are the principal domestic animals. The island produces rice, sugar, tobacco, hemp, coffee, cocoa, bananas, sweet potatoes, melons, and valuable timber. The coconuts are the finest in the world. The climate is mild, but typhoons frequently sweep the island and do great damage.

Agana, a thoroughly modern city of 8,000 inhabitants, is the capital, and San Luis de Apra is the principal port. The commandant of the naval station is also governor of the island; he is appointed by the president of the United States. There are few pure-blooded members of the original Malay inhabitants left, the natives being of mixed Filipino, Malay, Japanese, Chinese, and Spanish blood. Population, about 14,000.

GUATEMALA (*ḡwä-tē-mä'lä*), Republic of. So abundantly has nature bestowed her gifts upon Guatemala, the most populous and by far the most important state of Central America, lying just south of Mexico, that the natives are wont to refer to it as "Paraíso," or "Paradise." With an area of 48,290 square miles, making it smaller than North Carolina, Guatemala includes a remarkable variety of scenery and climates.

You may travel from coast to coast on the interoceanic railroad, starting at sea-level in the early morning from Puerto Barrios on the Atlantic coast. You pass through richly foliaged banana lands, with the little towns that have sprung up to care for the workers, and then through many miles of uncultivated country with an endless variety of tropical vegetation. Here and there you may see the queztal, the national bird of Guatemala, with its brilliant and sparkling feathers, and millions of other birds of gay plumage. As you gradually ascend by a series of plateaus and terraced slopes the climate becomes more agreeable and healthful. In the great interior tableland, 5,000 feet or more above sea-level, perpetual spring prevails, with rains from April to October.

After crossing the lofty mountain backbone (10,000 to 12,000 feet), which runs within 50 miles of the Pacific coast, you arrive at Guatemala City (population, 90,000), the thrice-destroyed capital of the republic. After the terrible earthquakes and volcanic eruptions of 1541 and 1773, the people built the present city on a site which seemed safe from earthquakes, since the great cathedral, erected by the Spaniards in 1620, had stood for 150 years. Here for a century and a half "New Guatemala" throve, until the dreadful convulsion of 1917, when even the great church was shattered, and the little bright-colored adobe houses that used to glisten in the brilliant sunlight, together with the more pretentious dwellings, were all destroyed. Its loyal citizens at once set about rebuilding upon the same site, not wishing to abandon a railroad and commercial center so favorably situated upon the great divide between the Atlantic and Pacific.

From the capital you entrain for San José, the Pacific port, and get a glimpse of the richest and most densely settled lands of the republic. Although Guatemala is rich in gold, silver, lead, and other minerals and has immense forests of valuable timber (the Indian name Guatemala is said to mean "Land of Forest"), its chief industry is agriculture. Abundant rainfall and the fertile volcanic soil make possible two crops of wheat a year, three crops of corn, and rich yields of very fine coffee, of which nearly 100,000,000 pounds are exported annually. You pass plantations (more than half under German ownership) where hundreds of workers are picking coffee beans or working in the fields of sugar cane before you reach the little port of San José. Here you enjoy the excitement of being let down from the dock in a cagelike basket into a lighter below, for ocean vessels are not able to enter San José.

Pure Indians comprise fully 60 per cent of the people; of the remainder, classed as "Ladinos," or Latins, a large majority are half-castes and a smaller proportion pure whites. Population, about 2,000,000. (*See* Central America.)

Guelfs (*ḡwĕlfs*) and **Ghibellines** (*ḡĭb'ĕ-lĭns*). The rivalries of these two great political parties long distracted Germany and Italy. "Welf" (which became "Guelf" in Italian) was the name of a German ducal family which ruled Bavaria and Saxony in the Middle Ages, its most noted member being Henry the Lion (1129–1195), who was deprived of his duchies by the Hohenstaufen emperor Frederick I (Barbarossa). The rival battle-cries of these two families—"Hi, Welfen!" and "Hi, Waiblingen!" (the latter from a little village in Swabia near Castle Hohenstaufen)—were corrupted in Italy into "Guelf" and "Ghibelline," respectively. The Hohenstaufens stood for a strong monarchial government and for the imperial rule over Italy, while the Welfs represented feudal opposition to the monarchy and the independence of the Italian towns. The influence of the papacy was usually on the side of the Guelfs. After the fall of the Hohenstaufen emperors (1254), the larger issues between the two parties were lost sight of in petty feuds. By the 15th century the names Guelf and Ghibelline lingered only in Italy, where they came to mean little more than differences in the wearing of feathers in the cap, in cutting fruit at the table, in gestures in speaking or swearing, and the like.

The house of Welf (Guelf) continued to rule certain parts of Germany—Hanover and Brunswick—until late in the 19th century. With George I, in 1714, the Guelf (or Guelph) family came to the throne of Great Britain.

Guiana (*ḡē-ä'nạ*). That little known part of South America which lies between the Orinoco River, the Amazon River and its tributary the Rio Negro, and the Atlantic Ocean, is known to geographers as Guiana. In common usage, however, Guiana means especially the three colonies of British Guiana, Dutch Guiana, and French Guiana.

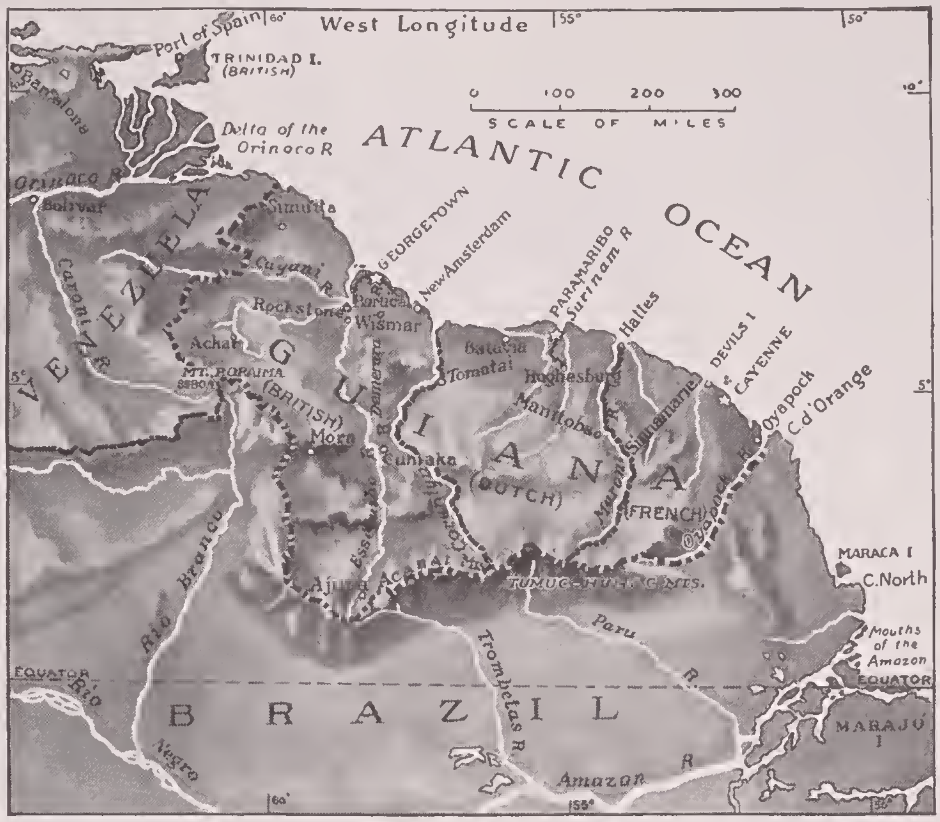
The coast is everywhere low, hardly rising above high water mark. For 20 miles inland the land was once a mangrove swamp, but it was diked and drained by the early settlers and thus made into fertile plantations. Along the shores and on the banks of the numerous rivers, where similar plantations have been formed, live the scanty population. Beyond the stretches of rich heavy loam brought down by the rivers, lie low ridges of sand and shells, showing where the coast line was in former ages. Farther inland the country rises into a rocky hilly plateau (3,000 to 4,000 feet above sea-level), covered with primeval and almost impenetrable forests, except where grassy plains or *savannas* occur. The ranges of low mountains and hills which traverse this plateau are rich in gold, aluminum ore, and other minerals.

Luxuriant Life of the Forests

In the perpetual summer of the hot moist climate vegetation flourishes. The district is noted for the height and variety of its trees, many of them furnishing valuable woods; and for the size of the leaves and flowers. Orchids sometimes grow in large masses with flower-stems 12 feet high, and gigantic vines festoon the trees. In the lagoons and rivers grow many kinds of water-lilies; the largest, the famous *Victoria regia* with leaves five or six feet across, was brought from British Guiana and distributed over the civilized world. Alligators and great fish of innumerable species abound in the rivers, and the forests are filled with richly-plumaged birds, such as the scarlet ibis, white egret, and flamingo; reptiles, and such wild animals as the tapir, sloth, ant-eater, jaguar, and monkey. The insects are remarkable for the great number of varieties represented and for the brilliance of their coloring.

The Guiana coast was first sighted on the third voyage of Columbus in 1498. During the 16th century many Spanish and Portuguese adventurers made unsuccessful visits to its rivers in search of the fabled El Dorado. Sir Walter Raleigh led several expeditions and was beheaded soon after his last disastrous voyage. By the middle of the 17th century several British, Dutch, and French settlements had been founded. The colony of Surinam, now known as Dutch Guiana, was given up in 1667 by the British to the Dutch in return for the surrender of their claim on New Amsterdam, now New York.

THE THREE GUIANAS



You can see at once why the British, the Dutch, and the French were each glad to own a section of the Guianas. They are abundantly watered by rivers, and the alluvial coast plain, which was at one time under the sea, is now drained and diked, making rich productive land. Back of these lowlands the land rises, and still farther back there are hills, some of which are 2,000 feet high. This region is covered with great forests, with savannahs here and there, while farther south rise mountain ranges.

British Guiana, as its boundaries stand after decades of wrangling with Venezuela, contains about 90,000 square miles, and has a population of about 310,000. It is the only British possession in South America, aside from islands. More than two-thirds of the people are negroes and Hindu coolies brought in as laborers. There are between 15,000 and 20,000 Indians and about 3,500 Chinese. The Europeans are mainly Portuguese and British. Sugar, rum, molasses, gold, timber, rice, and balata (a substitute for gutta-percha) are the chief exports. There are only about 100 miles of railway, and transportation is carried on chiefly by water. The capital, Georgetown, which has a population of nearly 55,000, is below high-water mark and has to be constantly drained by canals and steam pumps. It is protected from the sea by a stone wall a mile long, and the houses are built on high piles. The governor of the colony holds his office by appointment from the British government.

Dutch Guiana, sometimes called by its old name Surinam, is about half the size of British Guiana, with a population of about 110,000, chiefly Hindu coolies, Chinese, Javanese, negroes, and other laborers. The most interesting people are the "bush negroes," descendants of runaway slaves who escaped to the forests and gave the government so much trouble in the latter half of the 18th century that it had to make treaties with them and grant them subsidies. Before missionaries had worked among them they had relapsed into a curious heathenism blended with survivals of Christianity. Cacao, coffee, sugar, rice, corn, bananas, and gold are the chief products; but the revenues of the colony fall below its expenses and have to be supplemented by grants from the Netherlands government. Nearly half the population live in Paramaribo, the capital.

French Guiana is the smallest of the three colonies, with an area of about 32,000 square miles and a population in the neighborhood of 30,000. It has always had a bad name from the terrible disasters which attended early attempts at settlement. In 1763 a colony of 12,000 came from Alsace and Lorraine, which was reduced after two years of hunger and disease to a fever-stricken band of less than 1,000. During the French Revolution it was made a convict settlement and is still used for that purpose. Devil's Island, near its coast, is famous as the place where Captain Alfred Dreyfus was imprisoned, the victim of an army plot which kept France in a political uproar for a decade. There is little industry and the imports exceed the exports. The capital of French Guiana is Cayenne, which gave its name to the red pepper of that name.

GUINEA-FOWL (*gĭn'ĭ-*). What a noisy creature this barnyard fowl is, with its unceasing cry like the rapid creaking of a rusty hinge! But it is becoming one of the most profitable inmates of our poultry yards, owing to the growing liking for its dark gamy flesh. The birds have a full squarish body, a small head and short tail, and very thick beautiful grayish plumage, marked with small white spots. They came originally from Africa and were common from the Guinea coast southward to the Cape of Good Hope. They are also found in the northern part of that continent where they have been domesticated since the days of the Romans.

The wild guinea-fowls are of three kinds—those with a crest of feathers on the head; those with a bony helmet and bare heads; and those with a patch of feathers on the back of the head. The crested variety is more graceful than the others; their plumage is black, dotted with small bluish-white or light green spots. The skin of the neck is bare, bluish in color, and sometimes ornamented with bright red. The helmeted variety, from which the domestic form is derived, go in large flocks. They are very noisy, fast runners, wild and wary. Some species of this kind live also in Madagascar. The domesticated guinea-fowls are of three varieties — peach, white, and lavender.

Guinea-fowls destroy many insects, their eggs are good, and their flesh is esteemed as a delicacy. But they are hard to raise as they have the bad habit of hiding their nests, and they are unpopular on account of their harsh monotonous cry.

AN AFRICAN GUINEA-FOWL

This Guinea-fowl is a native of Africa, where the whole Guinea-fowl family originated. But he is more lean and long-legged than our domestic fowls and is one of the swiftest bird runners.

GUINEA-PIG. This restless grumbling little rodent is curiously misnamed, for it is in no sense a pig, and is not native to Guinea, but to Guiana, Bolivia, Brazil, and some other parts of South America. Its real name is the *cavy* and it is related to the hares and rabbits. It was domesticated in Europe in the 16th century, and is frequently seen in the United States. The cavy is about six inches long, and exists in several varieties, some of which have short hair and others long curiously ruffled hair. The colors are varied, usually black and white, tan and white, or a mixture of all three. The little animals are gentle and amusing and are bred as pets for children. They are also in great demand as subjects for experiment in medical laboratories. They live wholly on vegetable food and while feeding generally sit on their hind feet. When free they live in burrows and feed at dusk and on dark days. The guinea-pig breeds rapidly and is capable of bearing young when but a few months old. Scientific name, *Cavia cobaya.*

GUINEA-PIG BABIES

Here are eight of the little youngsters tumbling about—an average family, for the domestic Guinea-pig has from four to twelve young at a time, depending upon the age of the mother.

GUITAR (*gĭ-tär′*). A stringed musical instrument resembling the lute, well adapted as an accompaniment to the voice in singing and much used in Italy and Spain. It was introduced into Spain by the Moors. It has six strings, which are played by the fingers of the right hand, while those of the left control the pitch by pressing on the fingerboard, which has frets (metal strips dividing it into notes) across it. The three highest strings are usually of gut, the three lowest of silk spun over with silvered wire.

GULF OF MEXICO. This great oval indentation of the Atlantic Ocean, more than 700,000 square miles in area, is almost completely surrounded by the United States and Mexico. Look at the map and see how the peninsula of Yucatan reaches up towards the downward sweep of Florida as if to hold it in, and how, in the 450-mile stretch between them, a portion of Cuba interposes, leaving the Straits of Yucatan, 120 miles wide, opening into the Caribbean Sea to the south, and the Straits of Florida, varying from 60 to 100 miles wide, the only passages to the open sea. From east to west the Gulf measures 1,100 miles, and from north to south 800 miles.

The greater part of the 3,000-mile coast line is low and marshy. It is outlined for much of its length by long barren sand-bars, sometimes 100 miles in length, with salt lagoons behind them. There are no islands in the Gulf, except Cuba, a few small ones off the coast of Yucatan, and the luxuriant little Florida Keys. The rivers emptying into it all bring down a great amount of sediment, which forms great bars at the mouth, so that all of them, except the Mississippi, are nearly inaccessible except for vessels of small draught. Because of the low shores there are only a few good harbors, the most important being those of Key West, Tampa, Pensacola, Mobile, Galveston, Corpus Christi, Tampico, Vera Cruz, and Havana. From Florida to the Mexican boundary the slope of the basin is very gradual, but off the Mexican coast it drops rapidly to the submarine plain known as Sigsbee's Deep, which is about 12,750 feet deep. The tides are relatively small in range, as we should expect in such an almost land-locked basin, rarely exceeding 4 feet for the spring tides and 2½ feet for the neap tides.

The Gulf exercises a great influence on the climate of the southeastern states and the whole Mississippi valley, saturating the southerly winds blowing across it with moisture, which falls as rain, most heavily on the coast and in smaller and smaller quantities toward the north. The temperature of its waters is eight or nine degrees higher than that of the Atlantic.

The Gulf of Mexico has had a long and vivid history. In Yucatan stand great ruins, remains of times before recorded history. Into its broad blue waters Cortez and his armies sailed on his expedition of conquest, and many other Spanish and French adventurers followed him. La Salle floated down the Mississippi out upon its surface and was later killed near the settlement he founded on its coast. Early in the 19th century Jean Lafitte, pirate and smuggler, established his headquarters on the island of Grande Terre in Barataria Bay and plundered traders and terrorized settlers. During the War of 1812 and the Civil War, important naval battles were fought at Mobile Bay and at New Orleans.

GULF STREAM. Because it carries warm water from the tropics to temper the climate of the north, the Gulf Stream has been called the "heating apparatus" of western Europe. It is the largest and most important of all the ocean currents, having a volume equal to all the rivers of the world combined. If the water that flows by the Straits of Florida in one hour could be evaporated, the remaining salt would require many times more than all the ships of the world to carry it. This great ocean river, a clear indigo-blue mass of water several degrees warmer than the surrounding ocean, is 50 miles wide at its narrowest point and its depth is about 2,000 feet. It flows at a velocity ranging from two to six miles an hour.

The stream receives its name from the Gulf of Mexico, where it originates. Driven by persistent ocean winds, aided by the rotation of the earth, it rounds the Florida shore, and then runs close along the coast of North America, separated from it by the icy waters of the Labrador current (here known as the "cold wall"). Off Cape Hatteras it curves to the east, under the influence of the increasing westerly winds and the rotation of the earth. Fanlike, it spreads as it journeys, growing gradually wider, shallower, and cooler, and merging in the general drift of warm water northeastward to Europe. As this Gulf Stream drift approaches the eastern Atlantic, it splits into two parts, one going south along the coast of Africa, and another turning north and dividing into three smaller currents which warm the British Isles, Scandinavia, and parts of Iceland. That is one reason why London and Paris, although no farther south than parts of ice-bound Labrador and Canada, enjoy a fairly mild climate, and Norway and Iceland are made habitable. Although scientists today consider the Gulf Stream a less important factor in the climate of Europe than they used to think it, there seems little room for doubt that it has a part in warming the southwesterly ocean winds which give the western coast of Europe so much milder a climate than corresponding latitudes on the east coast of America. The Gulf Stream serves another important purpose in keeping the harbors of northwestern Europe free from ice. (*See also* Ocean; Winds.)

Long-Distance FLYING CHAMPIONS *of the World*

GULLS AND TERNS. So far as we know, Mr. Gull was the first flyer to cross the Atlantic. Many reliable observers have testified that they have seen the same bird follow a vessel the whole 2,500 miles from the coast of Ireland to the harbor of New York, living on the refuse thrown out from the ship and occasionally resting, hydroplane-like, on the waves. As you would expect in birds capable of such long flights, the gull's wings are very long and powerful, able to make steady headway against the strongest gales. And it has webbed feet, so that it is equally at home in the water.

All gulls are great travelers, and most of them migrate enormous distances between their winter and summer homes. But the record for long-distance traveling does not belong to the gull, but to its near relative the tern. The Arctic tern regularly makes a round trip of about 22,000 miles between its winter and summer homes, for it nests as far north as land has been discovered, and as soon as the young are grown the whole family takes wing for the Antarctic continent. Both gulls and terns have amazing homing instincts and when taken about a thousand miles from home, will find their way back in a few days.

Those beautiful long wings have carried this mother Tern all the way from the other end of the world to her summer home in the Arctic region. In the fall, as soon as her young ones are grown, the whole family will start for the Antarctic region.

Gulls and terns are the most widely distributed group of the bird family, for there are about 50 species of each, scattered throughout the world. The gulls range in size from that of a pigeon to that of a goose, and terns are slightly smaller, with slenderer bodies. All these birds are very sociable and nest in colonies of thousands and sometimes millions. When they are disturbed they utter a series of harsh screams which almost deafen the intruder. But such destruction has been carried on in some of their breeding colonies, for the sake of the edible eggs, and so many of the adult birds have been slain for their plumage, that gulls have disappeared from whole areas of the American coast.

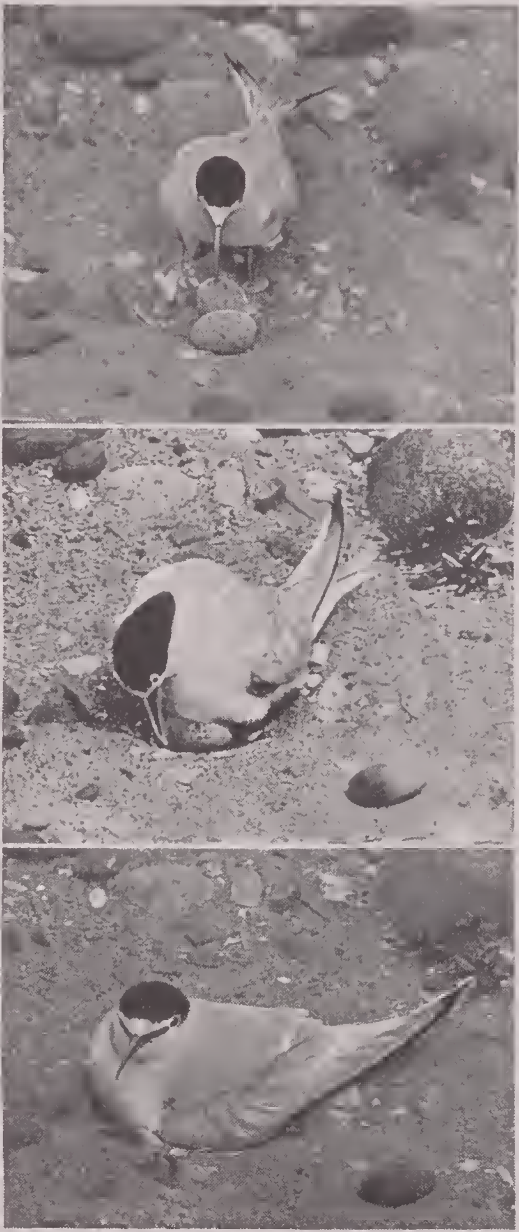
The prevailing color of the grown bird is white below and pearl gray above. In some species the head is more or less marked with black in summer.

A few species are dull gray all over. The feet and bill are usually bright yellow or red.

This is a Roseate Tern. This species of "sea swallow" is among the largest members of the family.

All gulls and terns are fond of fish, and greedily eat dead ones as well as any food refuse found floating on the water; thus the harbor and shore gulls are valuable scavengers. Inland gulls are valuable friends to the farmer because they eat field mice and the insect pests which do such harm to crops and trees. In Salt Lake City a monument, surmounted by bronze figures of two gulls, has been erected "in grateful remembrance" of the service rendered the state of Utah by gulls when, in 1850, the gulls came in large flocks and destroyed millions of black crickets, whose ravages for three years had threatened not only the crops but even the very lives of the settlers. (For illustrations in colors of common tern or "sea swallow" and herring gull, *see* Birds.)

HOW MRS. TERN TURNS HER EGGS


Mother birds turn their eggs from time to time so that all parts will be equally warmed, but instead of first snuggling down on the eggs and then shuffling them about as hens do, Mrs. Least Tern rolls them around under her with her beak.

The herring gull is the species most abundant along the Atlantic coast, acting as scavenger in the harbors and following ships for scraps of food. It is very fond of clams, which it breaks open by dropping them from a height on the rocks. One case has been observed where a gull repeated this performance 14 times before the shell finally broke.

The California gulls are found not only along the coast of California but inland as far as Utah. It was this species that rid the Salt Lake country of its crickets. The birds nest about inland lakes and follow the irrigating ditches, often in company with the ring-billed gull, which is one of the commonest western varieties.

Franklin's gull is the common gull of the lakes and marshes of the upper Mississippi valley. These birds often follow the plow of the farmer, picking up worms and grubs, so he calls them his "prairie pigeons." Their nesting habits differ from those of other gulls. In great companies they seek marshy lakes, where they build floating nests only a few feet apart. The fledglings swim from the nest when only a few days old, making the lake fairly alive with floating puff-balls.

Here you see two little Arctic Terns just hatched, and beginning to move about and take interest in life.

The laughing or black-headed gull, found near the salt marshes of the Middle and Southern states, is a handsome bird with a black mantle and a white breast flushed with rose. It is noted for its loud laughter-like cry, and for its trick of alighting on the pelican's head and snatching fishes from its huge beak.

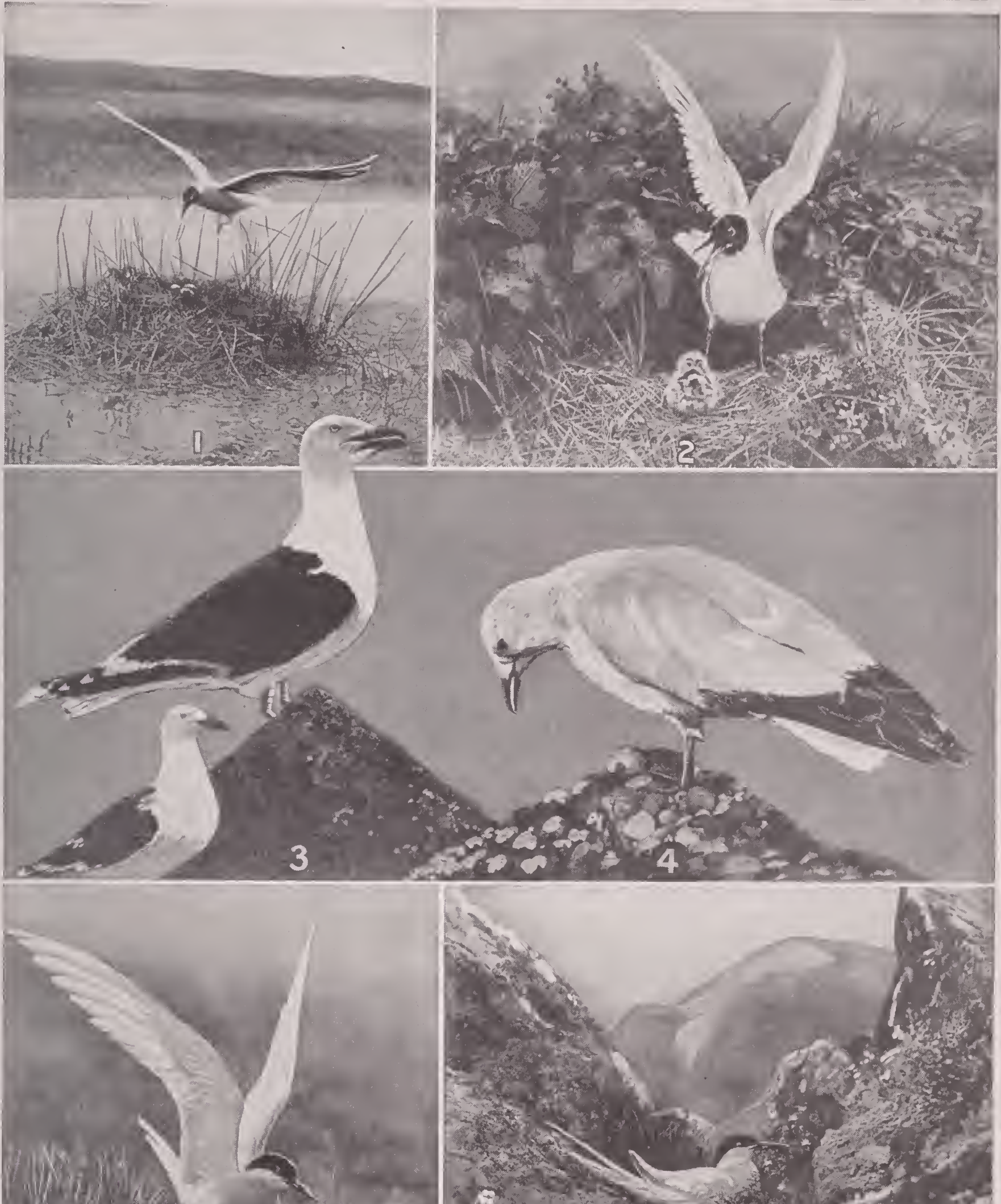
It is easy to tell terns from gulls, if you look closely at them. The terns are smaller and slenderer, and are more graceful in flight, as their nickname "sea swallows" indicates. Gulls usually have square tails, while most terns' tails are forked. A surer distinction is the upper bill, which is always ridged and hooked in the terns. Their habits also differ, for gulls often alight on the water to feed, while terns always hover and plunge for their food. Another distinction is that gulls usually fly with their bills on a line with the body, while terns carry theirs pointed downward.

The common tern is found in all parts of the Northern Hemisphere, as well as in South America and Africa. They often hover over schools of fish, and fishermen find them of great service in the locating of fish for them. The royal tern is not only the most conspicuous of the family, but is one of the handsomest. It is entirely white or pearl gray except for its glossy black crest, black legs, and a bright orange-colored beak.

The least tern is the daintiest of all sea birds. Only about nine inches in length, it is a pale blue color above and white beneath. But its slender pointed wings and tail have made it a prey to the feather hunters, who pursue it so cruelly that even rigid laws have not sufficed to protect it.

Gulls and terns compose the family *Laridae* of the order of long-winged swimmers, *Longipennes*. Scientific name of herring gull, *Larus argentatus*; common tern, *Sterna hirundo*.

SOCIETY NOTES ABOUT GULL AND TERN LIFE



1. Mrs. Black-Headed Gull is returning to her nest after an afternoon's call on the neighbors. 2. Baby Black-Head has been caught crawling out of his nest and is getting a good scolding. 3. The Great Black-Backed Gull seems to be posing for his picture, while his mate looks on. 4. The Herring Gull is looking around for a bite to eat. 5. Mrs. Arctic Tern is rising from her nest at the approach of an intruder. 6. Mrs. Roseate Tern is at home.

GUMS. The gums with which we are most familiar are those used for chewing, such as chicle, cherry gum, and spruce gum, but gums have important industrial and medicinal uses also. All gums are the juice or sap exuded from certain trees or shrubs. There are about 150 varieties known to commerce, most of which are used in varnishes, candies, drugs, and various industrial preparations.

True gums are partially soluble in water, but not in alcohol, while waxes and resins are soluble in alcohol and not in water. In popular usage, however, the word gum is applied also to true resins and to gum resins, or mixtures of gum and resin (*see* Resins). The purest and best gums come from various species of acacia (*see* Acacia). Most chewing gum is made from chicle gum, which comes from the naseberry, a tree of tropical South America, somewhat like the India rubber tree (*see* Chewing Gum).

Gum arabic is one of the most useful of the gums. It is brought into the market in the form of roundish tears, which vary in color from garnet red to light straw, and are always more or less transparent. The lightest colored varieties are the best. It is employed in the manufacture of confectionery, such as marshmallows, gumdrops, and "Turkish delight," and used in pharmacy for soothing and softening lotions. It is also used in making mucilage and adhesive paste, to give luster to crepe and silk, and to stiffen other fabrics. It comes from varieties of acacia in Turkey, Australia, northern Africa, and to a limited extent, in Texas and Mexico.

Gum tragacanth, which comes from Asia Minor, will take up as much as 50 times its weight of water, and thus makes a thick mucilage. It is used also as a thickener for colors and mordants in calico-printing; in medicine as a vehicle to bind insoluble powders; and in preparing beetles and other insects as museum specimens. Bassora gum, from a species of cactus, is similar to tragacanth and is sometimes used to adulterate tragacanth.

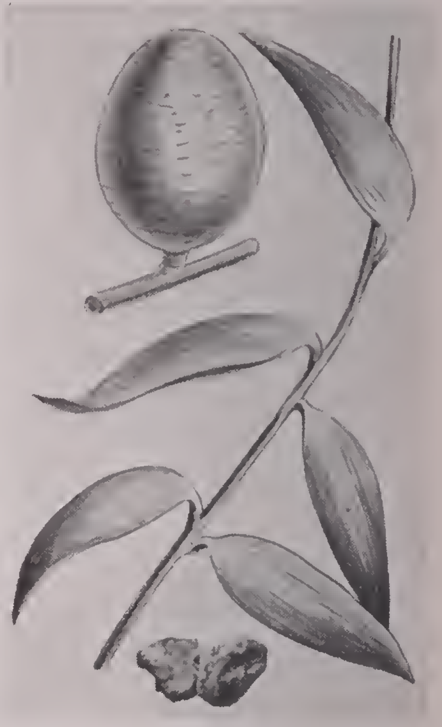
THE USEFUL TRAGACANTH

The lump of Gum Tragacanth you see underneath the plant will take up enough water to make 50 times its own weight of mucilage.

Kauri gum is the resin of the kauri pine of New Zealand. Most of it is obtained in fossil form. It is used in making fine varnishes. The copal gums, which are also used in varnishes, are fossil resins from Zanzibar, Madagascar, and many places in the East.

Other important gums are gamboge, a gum resin obtained in Siam, Cochin China, and Ceylon, used as a yellow pigment and in medicine; mastic, which comes from the eastern Mediterranean countries and is used in Turkey as a chewing gum, and elsewhere in pharmacy, and in making a very fine varnish. Plastic gum is another name for gutta-percha (*see* Gutta-Percha).

THE KAURI AND ITS GUM



Most Kauri Gum is obtained by digging up the fossil deposits left by the kauri trees of past ages. This picture shows the leaf, the cone, and the fossil gum.

GUNCOTTON. A violently explosive substance made from cotton or some other form of cellulose treated with nitric and sulphuric acids. It is largely used in naval and military mines and torpedoes. (*See* Cellulose; Collodion; Explosives.)

GUNPOWDER. The date of the invention of gunpowder is in doubt. In fact, it cannot be said to have been invented by any one man, for it was a gradual development from various "fire" substances, long known in many countries before they were adapted to military use. The Chinese early had a knowledge of some such incendiary substance; and the "Greek fire," first used by the defenders of Constantinople against the Saracens in 673, is believed to have been somewhat similar to modern gunpowder. It was not employed to propel balls, however, but was simply set on fire and poured or hurled on the besiegers beneath the walls.

The English Franciscan friar Roger Bacon (died about 1294) and the German monk Berthold Schwartz (early 14th century) share the honor of having been the first to give a scientific account of the composition of gunpowder. The use of it in cannon is first mentioned in the records of the city of Florence, under the date 1326. One chronicler mentions the use of cannon in the battle of Crécy (1346), but if used they did little more than frighten the horses and men. Gunpowder's first important use was in blowing up or battering down the castle walls of rebellious barons. Later it was used in small arms and helped to make the common man with a musket more effective in war than the mounted knight in armor.

The gunpowder of the early days was much the same as the common black powder of today. It consisted of a mixture of saltpeter (potassium nitrate or niter), charcoal, and sulphur. The proportions of these chemicals have varied greatly from time to time, a fair modern standard being 75 per cent saltpeter, 15 per cent charcoal, and 10 per cent sulphur. These ingredients are ground to a fine dust, thoroughly mixed into a moist paste, pressed into cakes, and dried. The cakes are then broken by rollers into grains of varying size, which are glazed by friction against each other in revolving barrels. The charcoal used in gunpowder is specially prepared from dogwood, willow, or alder. All operations are carried on in small separated buildings that so the danger of great destruction by accidental explosions is reduced to a considerable extent.

Except for blasting work and certain special military purposes, the old style gunpowders have been almost entirely replaced by the smokeless powders and the high explosives, such as guncotton, nitroglycerin, and dynamite (*see* Dynamite and Nitroglycerin; Explosives). Smokeless powders (products of guncotton and nitroglycerin) were first perfected in 1884 and put to military use by the French.

GUSTAVUS ADOLPHUS, KING OF SWEDEN (1594–1632). For 12 years in the first half of the 17th century Germany had been devastated by the Thirty Years' War. Towns had been destroyed, men, women, and children massacred, and the country plundered. Everywhere the Catholic and imperialist party was triumphant, and it seemed as though the Protestant faith would be swept out of the land. But in 1630 the tide was completely turned by the appearance of a new leader for the Protestants—Gustavus Adolphus, king of Sweden, one of the greatest generals of modern times.

Born in Stockholm castle, he had been trained from childhood for his kingly duties. When he was only nine years old he began to take part in public affairs, and in 1611, at the age of 17 he had mounted the throne as Gustavus II. So carefully had he been trained that before he was 20 years old he had won a war against Denmark, and by 1630 he had extended his kingdom around the whole eastern shore of the Baltic by successful struggles with Russia and Poland.

GUSTAVUS ADOLPHUS BEFORE HIS LAST BATTLE

Gustavus Adolphus is praying for divine aid just before the Battle of Lützen. His army scored a brilliant victory, but the great king was killed. Near the spot where he fell a granite bowlder was placed on the day after the battle and in 1832 a cast-iron canopy was built over it.

Gustavus Adolphus was led to enter the Thirty Years' War not only because he was an enthusiastic Protestant, who hoped to relieve the misfortunes of the Protestant cause in Germany, but also because he dreamed of extending his kingdom even to German shores, so that the Baltic might indeed become "a Swedish lake." France under Cardinal Richelieu as minister gave him money for his expedition, to further French political aims.

When Gustavus landed in the north of Germany his army was not large, but it was well trained and disciplined. He was the greatest military genius of his age, being the first of modern commanders to supply his army from a fixed base instead of leaving it to live off the country by foraging and pillage. At first he was coldly received by the Protestant rulers of Brandenburg and Saxony, but they were brought to their senses after the awful destruction of

Magdeburg by the imperialist forces and the foolish religious policy of Emperor Ferdinand II. In the famous battle of Breitenfeld, near Leipzig (Sept. 17, 1631), Gustavus overwhelmingly defeated the imperialist army under its famous commander Tilly.

Gustavus then pushed westward, through the "priests' lane" of rich bishoprics and monasteries of the River Main, to Mainz on the Rhine, where he established his brilliant winter court. In the spring he again took the field, and a second time defeated and now mortally wounded the aged Tilly in Bavaria. In this emergency the emperor took the humiliating step of recalling the imperialist general Wallenstein, whom he had dismissed just after Gustavus had landed on German shores.

After weeks and months of maneuvering, one foggy day in November 1632, Gustavus succeeded in bringing Wallenstein to bay at Lützen, only a few miles from the site of his first great triumph. Again the Swedish troops gained the victory, but the battle was won at the cost of the life of their beloved king, for Gustavus fell wounded into the hands of the enemy and was dispatched as he lay. He was the greatest king that Sweden ever had. With his death "all moral and religious ideals died out of the Thirty Years' War," and it became a mere struggle for political power. (*See also* Thirty Years' War.)

GUTTA-PERCHA LEAVES

The leaves of the great Gutta-Percha trees grow in clusters at the end of the branch. They are usually about 6 inches long and 2 inches wide at the middle. The flowers are white and very small.

GUTTA-PERCHA. On the other side of the world, in the rain-drenched Malay Peninsula and the neighboring islands of Java, Borneo, and Sumatra, grow forests of huge gutta-percha trees. Their spongy wood is useless, but between the wood and the bark is found a milky juice or "latex," which when it is concentrated by boiling produces a reddish-gray substance something like rubber.

This is the gutta-percha which made the ocean cable possible and which has many other important uses. It is a non-conductor of electricity, is unchanged by water, and can be easily worked when warm, retaining its shape and becoming leathery but pliant when it cools. So perfectly does it fulfil the demands for cable insulation that five-sixths of the submarine cable mileage of the world has a gutta-percha covering.

Gutta-percha is often confused with rubber, because both are the dried juice of trees and resemble each other in many properties. Like rubber, gutta-percha is waterproof and can be "vulcanized" with sulphur, in which form it is often miscalled hard rubber. But it is not elastic, and unlike rubber it softens in warm water so that it can be drawn into fine sheets or molded into any form, retaining impressions to the finest detail when it becomes cold and hard. It is prized for making certain kinds of surgical instruments and plates for false teeth, and it is also employed in the manufacture of buttons, golf balls, knife handles, etc. Inferior grades are used in waterproofing.

Gutta-percha has been known in western countries only since the middle of the last century, but in China it has been used much longer. The world's supply is rapidly diminishing and may soon disappear unless the methods of collecting the sap are changed. Since the juice flows very slowly, the usual practice is to cut down the trees to collect the "latex," of which a large tree yields only two or three pounds. This wasteful method has exterminated the trees in many districts in which they were formerly abundant. In a few places the trees are tapped as for rubber, and a few plantations have been started. Because of the increasing scarcity of gutta-percha, rubber is replacing it for many uses, especially as a coating for land- and sea-cables.

The trees supplying gutta-percha belong to the order *Sapotaceae*, the principal one being *Isonandra gutta*. The true gutta-percha is obtained from trees found only in the Malay Peninsula and its vicinity, although several natural substitutes are obtained from other trees and plants, of which the material known as "balata" or "Surinam gutta-percha" is the most valuable. This is obtained from the bullet tree, *Mimusopa balata*, which grows in the West Indies and South America. Various artificial substitutes have been invented, chiefly for use in electrical insulation. They consist of mixtures of bitumen with linseed and other oils, resins, and other similar substances.

GYPSUM. This is a very abundant mineral composed of calcium sulphate in combination with water. Translucent varieties are known as "selenite," and very fine grades of the material, of white color and special luster, are known as "alabaster." When heated, part of the water of the gypsum escapes and the mineral becomes a white powder known as "plaster of Paris," the name being due to the fact that gypsum was early used near Paris for the making of plaster or cement. If moistened, this powder "sets." Plaster of Paris is used for making casts by sculptors and in surgery. When the material sets it increases a little in volume, which makes all the details reproduce exactly. Plaster of Paris is also used sometimes in making stucco, and for fertilizer on land, where it facilitates the decay of forms of alkali.

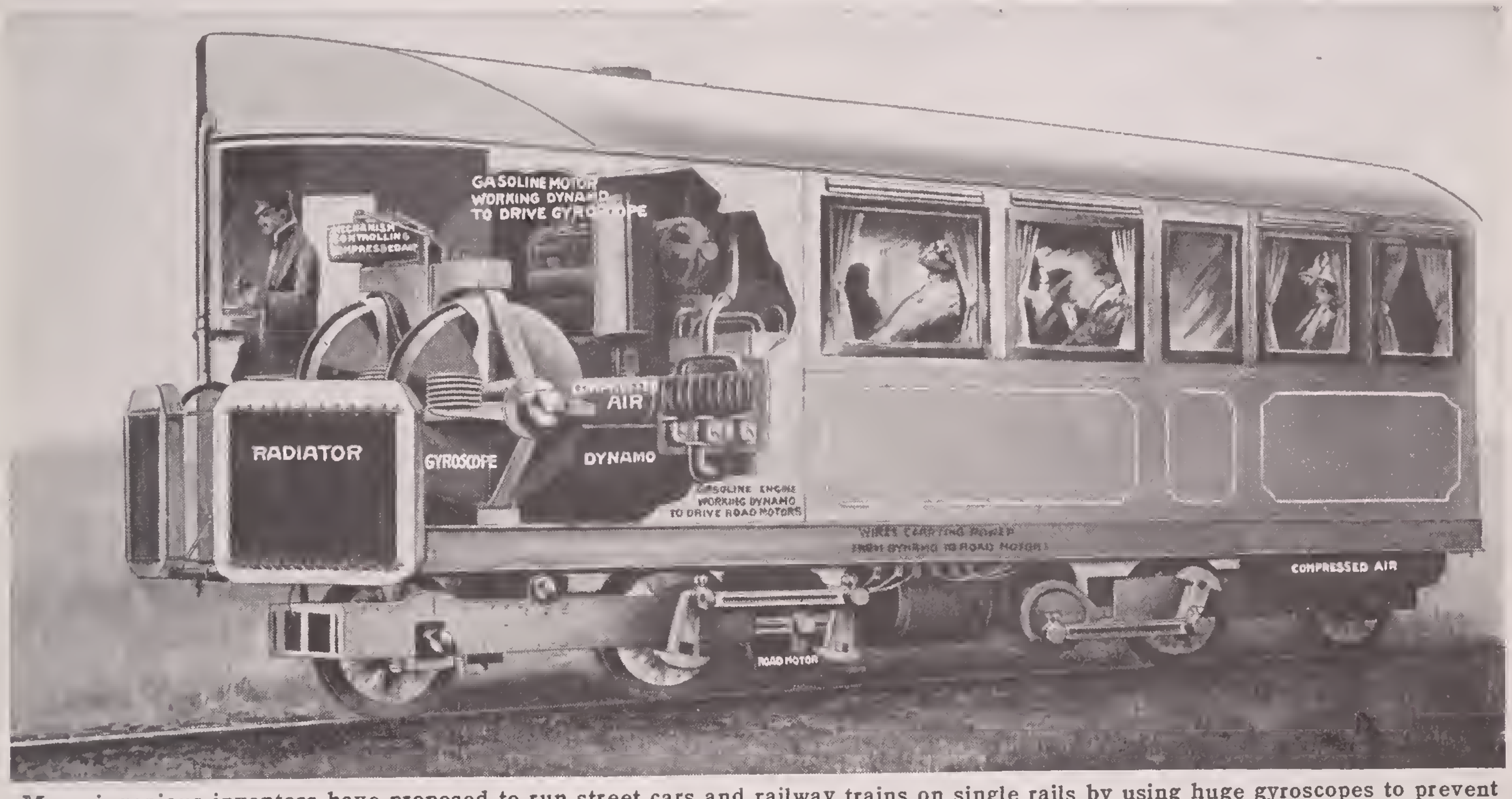
For making plaster of Paris the whiter and purer grades of gypsum are ground in mills and calcined in large kettles, which are usually about six feet deep and eight feet in diameter. Heat is applied from below and revolving arms constantly stir the gypsum.

Other important uses for gypsum are as a filler in paper and in the manufacture of ornamental stucco work. Much gypsum is also used for beds in polishing plate glass. Raw gypsum is used as a basis for paints, to which the pigments are added. Calcined gypsum mixed with a small amount of sodium or potassium sulphate is used for flooring, ceilings, or walls.

Gypsum occurs in various states of the United States, notably Iowa, Kansas, Michigan, New York, Ohio, and Texas. The workable beds are deposited in salt lakes. As the salt water becomes more and more concentrated, the gypsum is precipitated before the salt. Gypsum is therefore often associated with salt deposits. It also occurs in many sedimentary rocks in the form of single crystals or in groups of crystals. In some parts of the West, as in parts of New Mexico, gypsum occurs at the surface, and its fine particles are blown about like sand.

GYROSCOPE. (*ǵȳ'rō-skōp*). You know how a top will remain upright in resistance to the force of gravitation as long as it keeps spinning. Now imagine a wheel-shaped top, pivoted top and bottom inside a framework, and rotating rapidly. It will give to that framework the same strong tendency to remain at the angle at which it is placed that the top has when it is spinning alone. In other words, the axle of the rotating wheel cannot be turned quickly from its position except by the application of some strong force. This is the principle on which that mysterious device called the gyroscope works, whether it is the toy that everyone knows, or the elaborate apparatus which men of science have applied to important stabilizing purposes at sea, on land, and in the air.

THE CAR THAT RUNS ON ONE RAIL


GASOLINE MOTOR WORKING DYNAMO TO DRIVE GYROSCOPE
MECHANISM CONTROLLING COMPRESSED AIR
COMPRESSED AIR
RADIATOR
GYROSCOPE
DYNAMO
GASOLINE ENGINE WORKING DYNAMO TO DRIVE ROAD MOTORS
WIRES CARRYING POWER FROM DYNAMO TO ROAD MOTORS
COMPRESSED AIR
ROAD MOTOR

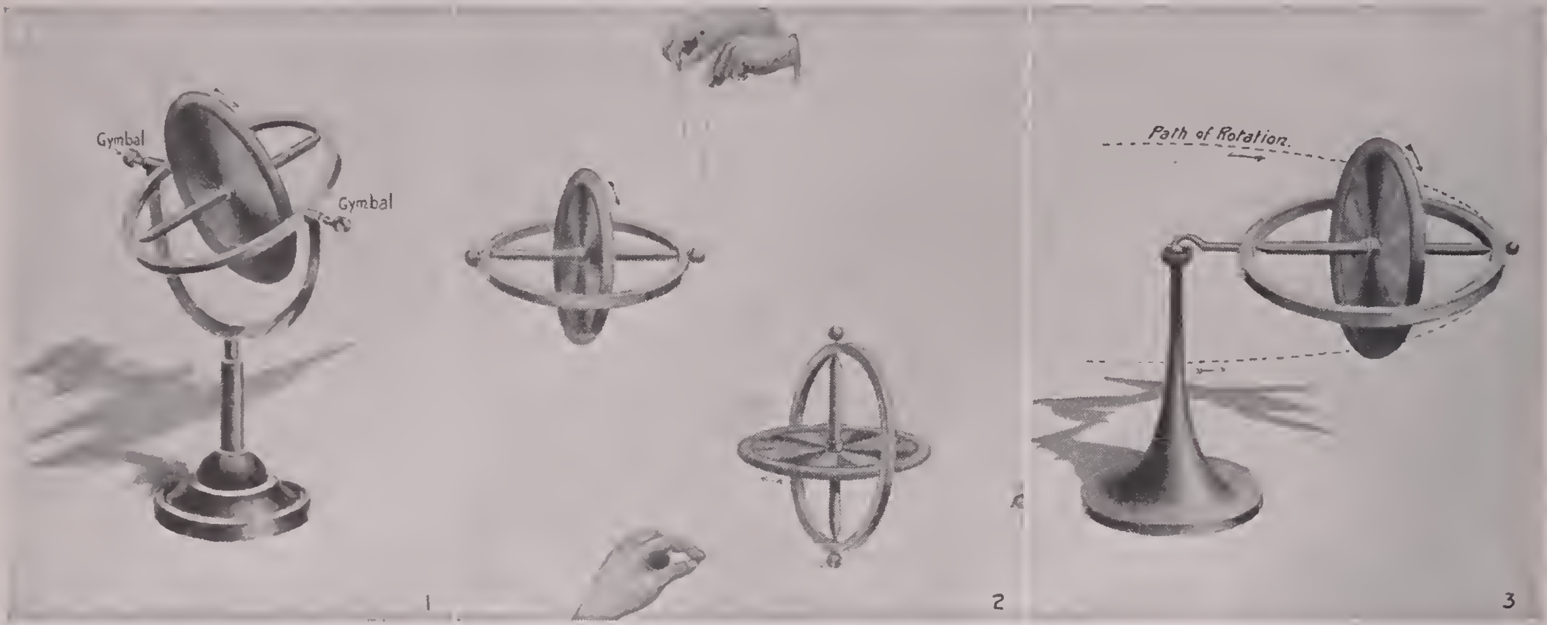
Many ingenious inventors have proposed to run street cars and railway trains on single rails by using huge gyroscopes to prevent the cars from tipping over. Small models, such as this, have been built and operated with success. Some day, perhaps, we shall all be riding in such swift, smooth conveyances, held up by the mysterious force of heavy whirling wheels.

Every battleship in the United States Navy is now equipped with a gyrocompass (perfected by the American Elmer A. Sperry about 1910), which is entirely independent of the earth's magnetism and is much more accurate than the magnetic compass. The gyroscope is used in the steering mechanism of the torpedo to keep it straight on its deadly journey under the waves. It may also be used to steady the ship's telescope so that the navigator may make observations while the ship is rolling and pitching in a stormy sea; but even the rolling of a ship may be checked by Sperry's application of the gyroscope in the form of a huge stabilizer in the ship's hold. On the other hand, it has been possible by gyro apparatus to produce artificial rolling for ice-breaking vessels used in keeping ports open in winter.

On land, the gyroscope makes possible the monorail car, which remains upright even when rounding sharp curves on its track with a single rail; and in the air the gyroscope has been successfully used as a stabilizer for airplanes.

The fundamental principle underlying the gyroscope is that when a wheel or disk-shaped body is rotating rapidly about its axis, the body offers great resistance to any effort to change the direction of that axis. If you examine a toy gyroscope you see that it consists essentially of a heavy-rimmed wheel rotating on an axle mounted in a ring which itself does not revolve. When the wheel is rotated with sufficient speed the gyroscope performs surprising antics, such as running down a stretched thread without falling over, and spinning on the edge of a tumbler, or on the point of a lead pencil. You cannot push it over with-

SOME OF THE QUEER ANTICS OF THE GYROSCOPE



At the left you see how the principle of the gyrocompass is demonstrated. Set that disk spinning, point its axis in a certain direction, and you can tip the supporting frame in any way you wish, but the whirling axis will keep on pointing as it was first fixed. In the middle picture you see a gyroscope top holding itself up by its motion while it projects at right angles from a loop of string, and another top "walking a tight-rope." The picture at the right shows the "double motion" of a gyroscope whirling about a central point of support.

out applying a comparatively strong force, for it resists you with a force many times its entire weight. This same principle explains why modern rifles and cannon are rifled or bored to make the bullet or shell rotate, so that the gyroscopic action will keep the point of the projectile foremost as it whizzes through the air to its target.

When you do overcome the resistance and tilt the gyroscope—and you may tilt it at almost any angle short of actually toppling it over—you are astonished to find that not only does the wheel continue to spin at the new angle, but the whole apparatus turns in a circle about the spinning point, thus compounding two simultaneous rotations. This action has often been used to illustrate the various motions of the earth—its daily rotation about its axis, its annual revolution in its orbit, and a slow rotation or "wobbling" of its axis, called the "precession."

The gyroscope was invented probably in the early part of the 19th century, although by whom is uncertain. Its properties were studied by the French scientist Foucault in 1852.

HABEAS CORPUS (*hā′be-as côr′pŭs*). When a person is imprisoned or held anywhere against his will, a court of law may upon reasonable demand issue an order compelling the jailor or other custodian to produce the person in court and show by what right he is held captive. If no lawful reason is found the prisoner is released. This court order is called a writ of habeas corpus, often known as "the great writ of liberty." It is probably the most important of all legal safeguards against tyranny.

Habeas corpus is a Latin phrase meaning "produce the body." The principle of this writ is of ancient English origin, for in Magna Carta King John was forced to promise that "no free man shall be taken or imprisoned except by the lawful judgment of his peers and by the law of the land." Under this principle no one could be arrested and held in confinement on mere suspicion, without being formally accused of a crime.

This remained one of the mainstays of English liberty until Charles I set up the claim that a royal command was a sufficient answer to a writ of habeas corpus. This misguided policy with similar arbitrary acts cost the king his life. The result was that under Charles II the famous Habeas Corpus Act was passed, which extended the principle to mean that any person who was imprisoned for any crime except treason or felony, could demand and obtain his freedom under bail—that is, the pledge or bond of some responsible person to pay a fixed sum of money if the accused person failed to appear for trial.

The amusing manner in which this law passed the House of Lords is told by Bishop Gilbert Burnet in his memoirs. The lords who approved the bill had all filed out, as is customary when voting, and were returning to be counted as they entered the door, "Lords Gray and Norreys were named to be tellers," says Bishop Burnet. "Lord Norreys, being a man subject to vapors, was not all attentive, so, a very fat lord coming in, Lord Gray counted him for ten, as a jest at first; but seeing Lord Norreys had not observed it, he went on with this misreckoning of ten, so it was reported that they who were for the bill were the majority, though it indeed went to the other side."

The Constitution of the United States declares that the "privilege of the writ of habeas corpus shall not be suspended, unless, when in cases of rebellion or invasion, the public safety may require it." The privilege was suspended by President Lincoln during the Civil War, at first without the sanction of Congress. In 1863 Congress voted to give the President that power.

HABIT. The ordinary person thinks of smoking, chewing gum, or personal peculiarities such as holding one's hand on the side, as habits. He does not think of walking, skating, and catching a ball as habits, nor of the movements of his eyes in reading, or of his hands in playing a piano. Habit enters so largely into man's daily activities that it would be impossible for him to exist without it. He could not communicate with a friend without making use of the habits of enunciation or writing that he formed with great difficulty in childhood. If he had not made it a habit he might be occupied all day in dressing and undressing himself, for the fastening of a button or the combing of his hair would be as difficult as when he first tried it as a child. He would, moreover, be completely tired out from his exertions. But habit enables him to do these things speedily and accurately, yet almost unconsciously, and so leave his mind free for other matters.

Habit formation has been likened to the making of a path across a field. After the first traveler has trodden down the grass, the next is likely to follow in the same route, and so on until presently the grass is wholly worn away and everyone thereafter follows the beaten path. In the same way in the animal organism, nervous currents tend to employ those pathways which have been previously established, and thus many of our habits formed when we are young—such as posture, personal cleanliness, manners, and standards of dress, enunciation and tone of voice, and even moral habits—become permanently settled upon us. Prof. William James has told us of the drunken Rip Van Winkle who excused himself for each fresh relapse by saying, "I won't count this time." "He may not count it," says James, "but it is being counted nevertheless. Down among his nerve-cells and fibers the molecules are counting it, registering and storing it up to be used against him when the next temptation comes." To break up a habit means a complete change in the nervous system, and this can not be brought about solely by a penitent attitude of mind.

It is equally important for parents to remember that habits originate not only in conscious effort to do new things, but in conscious and unconscious imitation of what the child sees and hears about him. One of the main businesses of life is the formation of correct habits, for habits are the substance of conduct and character. To each of us comes the day when we realize the "law of human souls that we prepare ourselves for sudden deeds by the reiterated choice of good or evil that gradually determines character."

HADDOCK. A member of the cod family, resembling the common cod, but easily distinguished from it by the black lateral line, that of the cod being white. Though it usually ranks as inferior to the cod, it is nevertheless, one of the world's great food fishes. It is caught on the same grounds and by the same methods as the cod. "Finnan haddie" is smoked haddock. (*See* Fish).

HADES (*hā'dēz*). When the three greatest gods of Greek mythology, so the story goes, divided the world among themselves, Zeus obtained dominion over the heavens and upper regions, Poseidon became ruler of the sea, while Hades gained sovereignty over the underworld. Here in the realm of darkness Hades sat enthroned with his wife Persephone and ruled the spirits of the dead. He possessed a helmet which rendered him invisible. The Greeks pictured him as of stern and gloomy aspect, not to be moved by prayers and flattery. No temples were dedicated to him and when sacrifices were offered to him the ceremonies were dismal and only black animals were used.

So hated and feared was Hades as the god of the dead that the Greeks dreaded to call him by his real name. In later times they gave him a more kindly character and called him Pluto, "giver of wealth," for they believed that he controlled all the precious minerals that lay hidden in the depths of the earth, and even the grain that springs forth from the ground.

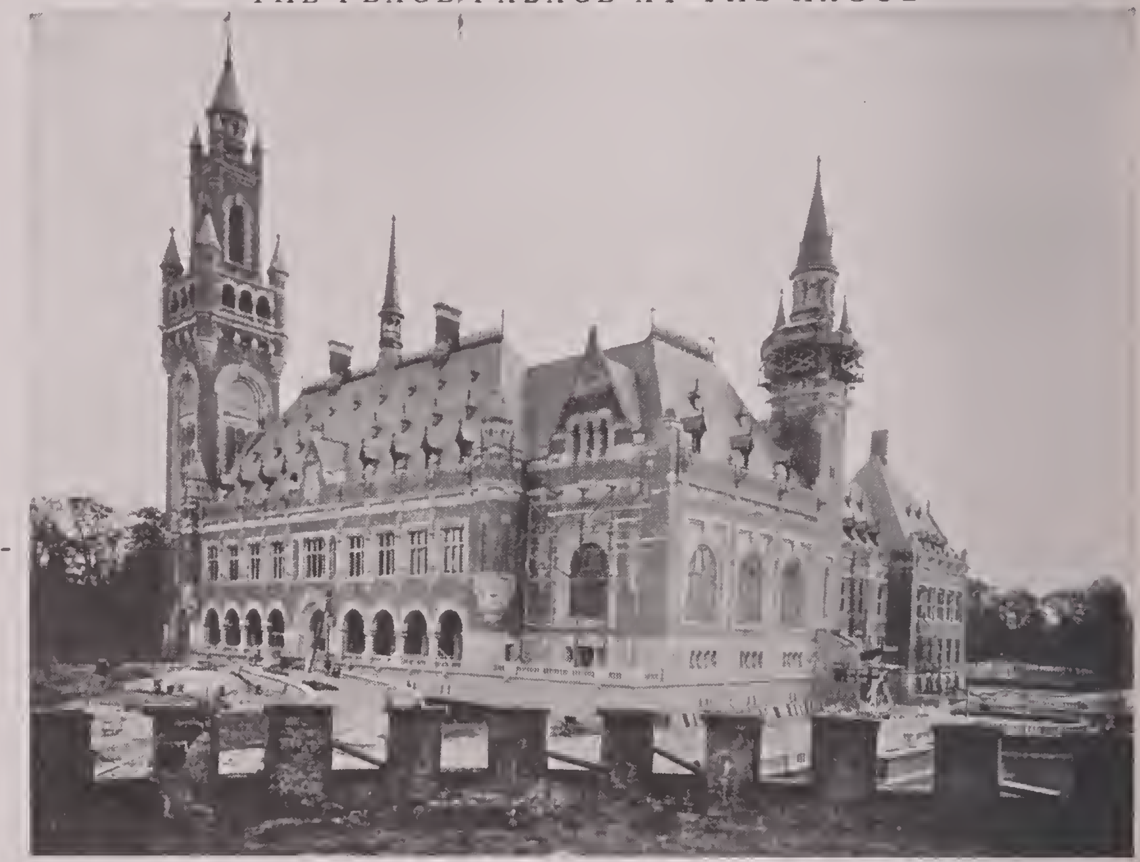
The term Hades came to be applied also to the abode of the dead. This was generally thought of as a place where the souls of the good and the evil alike led a dim shadowy existence, though there also grew up the idea of Elysium or the Elysian Fields, a paradise for those deserving special reward, and Tartarus, a deep pit under Hades where the wicked dwelt in eternal torment. Before passing into Elysium, souls drank of the waters of Lethe, the river of oblivion, that they might forget their sorrows.

To enter Hades, the dead were ferried across the River Styx by the boatman Charon. Only those who had received proper burial were allowed to go across, and if a body remained unburied, the shade must wander on the bank for 100 years before crossing. On the farther side of the Styx stood the many-headed dog Cerberus, guardian of the realm of Hades, who kept any who entered from returning.

HAGUE (*hāg*), THE. The capital of Holland, situated in a broad plain two miles from the North Sea, is like a plump and comfortable Dutch matron, clean and prosperous and well satisfied with life. Like Washington it is not a commercial city, but is chiefly occupied with the business of governing. It is the residence of the court of Holland, and it was for long the diplomatic capital of Europe, where many momentous international conferences were held. Since 1899 it has been the seat of the international court of arbitration, or Hague Tribunal, for which Andrew Carnegie built a splendid palace.

The original Dutch name of the city was "'s Gravenhaag" ("the Count's Grove"), which is shortened to "den Haag." The name comes from the fact that long ago the counts of Holland had a hunting lodge there. The city was once in a heavy wood, most of which has now been cut down. Only a little patch is left between The Hague and Scheveningen, the most popular seaside resort of the country, which is only a few miles from The Hague.

THE PEACE PALACE AT THE HAGUE



This beautiful building represents the dream of Andrew Carnegie and other workers for world peace. It was built to provide a home for the Permanent Court of Arbitration, and to house a library of international law.

Broad shaded streets intersected by many picturesque canals, and fine old buildings make the city one of the handsomest capitals of Europe. Its greatest pride is in its celebrated picture gallery, the Mauritshuis, which has many of the world's most beautiful and famous pictures. Here are masterpieces by the famous Dutch artists, Rembrandt, Rubens, Van Dyck, Vermeer, and others. There is also a very fine gallery of modern paintings which were collected by the eminent Dutch painter, Hendrik Willem Mesdag. Population, about 350,000.

HAGUE PEACE CONFERENCES. Before the World War of 1914–18, the most promising movements for world peace were the two peace conferences which met at The Hague in 1899 and 1907, on the call of the czar of Russia. Twenty-six countries, including the United States, attended the first, and almost twice that number were present at the second meeting.

The immediate objects of the conferences were (1) to find some basis on which the different countries could mutually reduce their armaments, and (2) to consider an agreement for settling international disputes by arbitration instead of war. Germany opposed both proposals. A member of the German delegation at the first conference said to one of the American delegates: "Germany is prepared for war as no other country is or can be. Arbitration would simply give rival powers time to put themselves in readiness, and would therefore be a great disadvantage to Germany."

German opposition prevented even the mention of disarmament in the second conference. The chief result of the meetings was the establishment of the Hague Tribunal, in the form of a permanent panel of judges to whom cases for arbitration might voluntarily be assigned (*see* Arbitration).

SIR DOUGLAS HAIG
Leader of England's Armies in the World War

Thirteen "conventions" or agreements were also adopted concerning various possible subjects of international disputes, and a series of regulations respecting "the laws and customs of war." Among other things, these prohibited the use of asphyxiating or poison gases in war, limited the use of submarine mines, and (for a limited period) dropping bombs from balloons and airplanes. Unfortunately the Hague regulations together with other provisions for making war more humane, were disregarded—first by the Germans and then by the other nations—in the World War of 1914–18.

HAIG, SIR DOUGLAS (born 1861). To the unwavering courage and military foresight of a scholarly gentleman of middle age, with a firm jaw and steady gray eyes, was largely due the final successes of the British arms on the western front in the World War. For the soldier on whom the British pinned their faith was Sir Douglas Haig, commander-in-chief of the British forces in France and Belgium.

At the beginning of hostilities Haig was a lieutenant-general, in command of Aldershot, England's great training camp. When the British army threw itself across the channel to stop the first German avalanche, he commanded the 1st Army Corps. In those black days his courage and optimism were a great help to the men, whose confidence he always held. In December 1916, he was appointed commander-in-chief with the rank of Field Marshal, and this position he held with honor till the end of the war.

Haig was born in Scotland, studied at Oxford, and joined the 7th Hussars in 1885. He saw his first active service under Kitchener in the Nile expedition, where he distinguished himself and was raised to the rank of major. He served also with distinction in the Boer War, and was made chief of staff to Sir John French, whom he afterwards succeeded as commander of the British army in the World War. At the close of the war he was created Earl of Bemersyde in the British peerage.

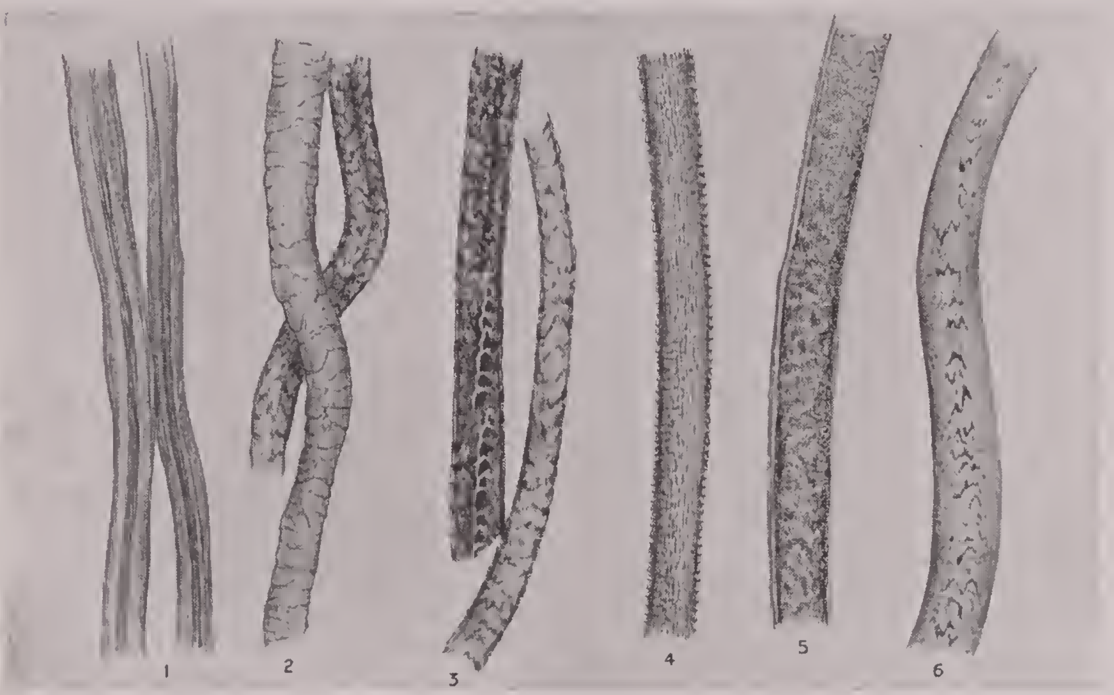
HAIL. The rolling white squall cloud that you sometimes see at the beginning of a thunderstorm is a "hail factory." The air in it is whirling along a line parallel to the earth. If a raindrop is caught and carried up high enough it turns to snow. When it comes down it is coated with water; on rising again, it freezes. The longer it travels the larger it gets; each coat freezes in turn until the mass of ice is so heavy that it falls to the earth in the form of hail. The more violent the whirl, the larger the hailstone will be before it falls. Some have been seen as large as eggs and there are records of storms in which hail covered the ground to the depth of a foot. Great destruction sometimes attends such storms, animals and even men being killed.

Frozen rain is sometimes called hail when it should properly be termed "sleet." Soft hail which sometimes falls in winter is merely a form of snow. Real hail is always a part of a thunderstorm, and therefore is most likely to occur on hot summer afternoons.

HAIR. The possession of hair is a distinguishing mark of mammals, as the possession of feathers is of birds, though the thickness of the hairy coat varies greatly in different creatures, and is even reduced to a few sparse hairs in such mammals as the hippopotamus and especially the whale. The possession of these warm coats of hair and feathers was one of the factors which enabled mammals and birds to develop so far beyond their common ancestors, the reptiles. Animals which live in cold regions—for instance, the Shetland pony and the polar bear—show a tendency to grow much heavier coats than those which live in a temperate climate. In some mammals, as the hog, the hair develops into long stiff bristles, in others, as the porcupine and hedgehog, these bristles are greatly enlarged and toughened to form protective spines.

In human beings no hair is found on the palms of the hands and the soles of the feet. The hair of the head is protective; the presence of hair elsewhere is probably only a relic of the heavy hairy coat worn by our remote prehistoric ancestors. The hair of the human head and beard is constantly being shed and replaced. Most of the lower animals have "shedding periods" when the hair begins to come out and to be replaced with new.

HOW HAIR DIFFERS FROM OTHER FIBERS



In these enlarged pictures you can see the difference between animal hair and such fibers as silk (1) which can be woven into smooth soft fabrics. Wool (2) is typical of all hair, with a rough scaly surface. Rabbit hair (3) also has large scales. Human hair (4) possesses a fine scale, while camel hair (5) and horse hair (6) have an almost horny surface. It is because of the scales, which interlock and cling together, that many kinds of animal hair can be matted into felt.

Each hair grows at its root from a tubular "follicle" or sheath in the skin. It is provided with a blood-vessel which feeds it and carries away its waste, glands which provide oil to keep it moist and soft, and nerves which control the blood-vessel and a muscle (the "hair erector") which by contracting makes the hair "bristle" or "stand on end," like the hair on the tail of an angry or frightened cat or the hair in the coat of an angry dog. When cold also an animal will sometimes "ruff up" its coat.

Each hair is a strong, flexible, elastic thread, composed of many horny cells. Some hairs are straight, others wavy, and still others "frizzy" or woolly. Microscopic examination of the cut end of a straight hair shows that it is round, while a curly hair is elliptical in cross-section. Anthropologists have used these differences in texture of human hair as a basis for classifying mankind into the straight-haired, the wavy-haired, and the woolly-haired (sometimes also the frizzy-haired) races, the first including the Chinese and other yellow peoples and the North American Indians, the second the "white" peoples, the third the negroes, and the fourth the aboriginal Australians and Nubians.

The color of hair is due to a pigment in the cells; this is lacking in white hair. The hair of the straight-haired, woolly-haired, and frizzy-haired peoples is uniformly black; the varying shades of brown, yellow, and red hair are found only among the wavy-haired peoples. Unhealthy conditions of the skin may affect the hair, making it dry or brittle or causing it to fall more rapidly than it should.

The hair of many animals is of economic importance. The hair of the sheep, goat, camel, vicuña, alpaca, and others is woven into cloth. The hair of rabbits, hares, and other animals is made into felt for hats. Cow-hair is used in making mortar and certain coarse cloths. The hair of horses is made into horse-hair cloth (used for stiffening garments and for upholstery) and into fishing-lines. The hair of the camel, badger, and other animals is used in making artists' brushes. Pig-bristles are made into various kinds of brushes.

HAITI (*hā'tĭ*), **REPUBLIC OF.** In the center of the chain of the West Indies, close to the east end of Cuba nestles the rugged island of Haiti. Only the western third is occupied by the Republic of Haiti, but this area contains three times as many people as the Republic of Santo Domingo in the east. No island in the world has been more favored by nature than this "black man's paradise," in which less than ten per cent of the people have any white blood. High mountains tower 7,000 feet above it, covered with valuable woods and filled with undeveloped mineral wealth in gold, silver, copper, iron, and coal. Rainfall is abundant, and the valleys are so fertile that the slightest attention can make them produce in tropical abundance.

Yet, in spite of its natural riches, no spot on earth was more neglected and poverty-striken until a few years ago than Haiti. Revolutions and misgovernment had reduced it to a miserable condition, and its capital, Port au Prince, was shunned by even the most enterprising travelers because of its filth. Then in 1915, the republic became a ward of the United States, and a new era dawned. In that year its president, General Guillaume Sam, was murdered, and a reign of terror began. European countries to which Haiti was in debt threatened to intervene, and the United States felt obliged, under its Monroe Doctrine, to send troops to restore order and administer the finances. Once begun, the task of supervising Haitian affairs had to be continued.

IN THE CAPITAL OF THE NEGRO REPUBLIC

It is market day in Port-au-Prince, capital of Haiti, and the people are crowding around the open air "stores" in front of the Roman Catholic cathedral. Until the American marines took charge in 1915, the city was exceedingly unclean and plague-ridden, but now the people have been taught to a great extent the value of public sanitation.

The United States "occupation" has done much to clean up the country and to stamp out the scourge of disease. The broad streets of the capital have been paved with asphalt, and scores of automobiles may be seen on them. The refuse and smells have departed; children have been made to attend school; electricity lights the capital; and a short tramway has been built, in addition to the railroad which connects the city with other important towns. The adjustment of taxes has given more incentive to agriculture, and in addition to excellent coffee, which still remains the chief export, Haiti produces increasing amounts of cocoa, cotton, tobacco, and sugar. Logwood (used for dyeing) and other valuable woods are exported, and plans are being made for the development of mineral wealth.

The people, however, are still low in civilization. The women do most of the manual labor, and all are ignorant and lazy. Although they are nominally Roman Catholics, the barbaric rites of Voodoo worship, a survival of African fetishism, still flourish in many parts. French is spoken throughout the republic, generally in an impure form called "creole." Area, 10,200 square miles. Population, estimated at about 2,500,000.

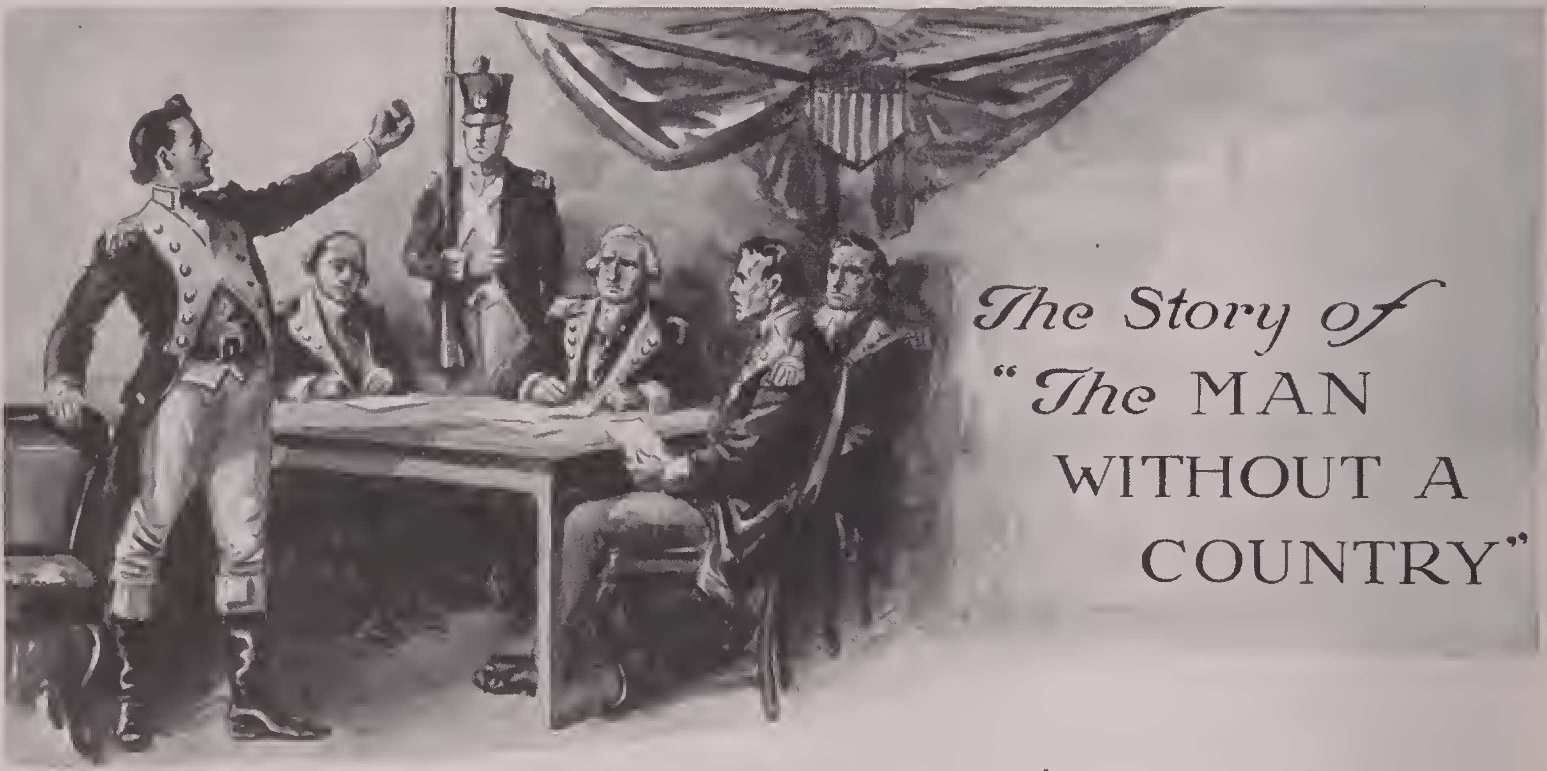
The history of the island has been a turbulent one ever since its discovery by Columbus, in 1492, when he named it "Hispaniola," or "Little Spain." Negro slaves were brought in after the extermination of the Indians, Spanish rule gave way to French, and native revolutions vied with pirates in maintaining constant disorder. In 1791 the blacks determined to abolish their masters, and under Toussaint L'Ouverture and his successor, Dessalines, the French were driven from the island. Since 1804, when the republic was organized, its history has been one of constant war, oppression, and revolution. Every president has been of the negro race, and many of them attempted to establish military despotisms. Of the first 36 presidents 15 were deposed by revolutions, 13 fled into exile, and 3 were assassinated.

HALE, EDWARD EVERETT (1822–1909). "If all the little children who have sat on Dr. Hale's knee were started in a procession four abreast from the State House steps, there would be a line of merry faces across the Common, out to the Public Library, over Harvard Bridge, and away beyond to remoter landmarks." These words, better than a record of all he did as preacher, social worker, and writer, help us to understand why Edward Everett Hale for two generations was not only esteemed but loved by the people of his native Boston as well as by all Americans who came to know him or his work.

After graduating from Harvard and studying theology, he entered the Unitarian ministry, becoming pastor of the Church of the Unity in Worcester, Mass., and later of the South Congregational Society, a Unitarian church in Boston. He was a leader not only in religious affairs, but in social and benevolent movements of many kinds. Societies such as the Lend-a-Hand Clubs, Look-Up Legions, King's Daughters, and King's Sons owe their beginnings to his inspiration, having as their motto his words: "Look up and not down; look forward and not back; look out and not in; and lend a hand."

To the country in general Dr. Hale is best known as the author of that "parable of patriotism," as it has been called, 'The Man Without a Country'. So real did this story seem that many thought it was a record of actual fact, until the author himself stated that it was his own invention. Fiction as it is, it is true in the highest sense, for since the time of the Civil War, when it was written it has been the means of instilling real love of country into the hearts of countless Americans. In the midst of many activities, Dr. Hale found time to edit religious and other journals, and to write or edit more than 60 books covering a wide range of subjects—fiction, travel, biography, history, and sermons.

Among his best-known works are: 'My Double and How He Undid Me' (1859); 'The Man Without a Country' (1863); 'Ten Times One is Ten' (1870); 'His Level Best, and Other Stories' (1872); 'In His Name' (1873); 'Philip Nolan's Friends' (1876); 'Boys' Heroes' (1886); 'Lowell and His Friends' (1899); 'Memories of a Hundred Years' (1900).



The Story of "The MAN WITHOUT A COUNTRY"

IN a square log-built room at Fort Adams, on the Mississippi River, in the year 1805—according to our story—a court-martial was held. A number of officers of varying rank were being tried in connection with the conspiracy of Aaron Burr. Among those who were brought before old Colonel Morgan, who acted as president of the court, was a young lieutenant, straight, tall, white-lipped, and defiant. As there was plenty of evidence against him, he was proved guilty.

"Do you wish to say anything to show that you have always been faithful to the United States?" Colonel Morgan asked him at the close of the trial.

His head flung back, his hands clenched, all the fire of his Southern blood released in one moment of blind madness, Philip Nolan cried out:

"Damn the United States. I wish I may never hear of the United States again."

The words came like a personal insult to that veteran of the Revolution, the white-haired Colonel. A silence fell on the court. When Morgan finally spoke, it was through lips as white as those of the offender.

"Prisoner, hear the sentence of the Court. The Court decides that you never hear the name of the United States again."

Nolan laughed. But his mirth ended abruptly, for no one else laughed.

"Mr. Marshal," continued the Colonel, "take the prisoner to New Orleans in an armed boat and deliver him to the naval commander there. See that no one mentions the United States to the prisoner. You will receive written orders from the officer on duty this evening."

The Beginning of His Punishment

Nolan, "the man without a country," was put on board a government vessel bound on a long cruise. The plan then put into effect was carried out through

WHEN NOLAN PROVED HE LOVED HIS COUNTRY

Aften seven years, during which Nolan was not allowed to see the United States or hear its name, he found himself on board a small American ship. Although he did not know it, the War of 1812 was being fought, and Nolan suddenly found himself in the midst of a naval engagement. All his suppressed patriotism came to the front, and he leaped to take command of a gun crew whose leader had been killed. "Fire, boys, we can't let them beat us!" he called, and served his gun the best of any on board ship.

his life. He was never allowed to touch land except in a foreign port, he was transferred from ship to ship as each came near the end of its homeward voyage. He was allowed every privilege of a first-class passenger—was given books to read, and he could write or otherwise occupy himself as he chose. He was permitted to talk freely with naval officers, but speech with the sailors was forbidden him unless an officer were present. All reading matter was carefully looked over before it was put into his hands, and references to the United States or to any of its affairs were carefully removed. He chose to wear the uniform of a lieutenant in the army, but the buttons which bore the insignia of his disowned country were removed, and plain ones put in their place. For this reason he was often called "Plain Buttons."

When a ship was in southern waters it was the habit of the officers and passengers to sit on deck in the warm lazy afternoons and read aloud.

Nolan had a pleasant voice and read well. His turn to read, therefore, was usually greeted with contented smiles. On one particular afternoon one of the younger officers had brought a copy of Walter Scott's recently published 'Lay of the Last Minstrel'. No one knew a line of the poem, but it was thought that, since it was a tale of the Scottish Border of two hundred years before, it was safe as far as Nolan was concerned. As he read he came to the famous lines on patriotism:

> Breathes there a man with soul so dead
> Who never to himself hath said,
> This is my own, my native land!

Nolan stopped short, turned a little white, but swallowed and went on—

> Whose heart hath ne'er within him burn'd
> As home his footsteps he hath turn'd
> From wandering on a foreign strand?

Here he choked, rose, and flinging the book into the sea, went into his cabin. He did not come out again for nearly two months. When at last he did emerge from his self-imposed confinement, he was a different man. He had lost his old swagger, and never read aloud again except from the Bible or Shakespeare. He spoke seldom, and then to very few people. His punishment was just beginning.

Gallant Action in the War of 1812

In the War of 1812 between the English and the Americans, Nolan did a very fine thing. He had then served seven years of his strange sentence, and was on one of the small men-of-war which the navy of that time boasted.

An English frigate opened fire, hitting the port of the American ship, killing the officer of a gun crew and several of the men. Then suddenly Nolan stepped forward.

"Fire, boys, we can't let them beat us," he called in a voice that put courage into the hearts of the fearful, and cheered those who had lost hope. He took full charge, loading the gun, showing the men how to handle heavy shot, sitting on the gun while it cooled, although this exposed him to the heavy fire of the enemy, and getting it reloaded oftener than any other gun on board.

When the skirmish was over and the English commander had surrendered, the commodore said:

"Where is Mr. Nolan? Ask Mr. Nolan to come here." When he appeared, "Mr. Nolan," said the commodore, "we are all grateful to you today; you are one of us; you will be named in the dispatches." And taking off his own sword of ceremony he presented it to the prisoner. Nolan was so happy he wept like a child.

Nolan *was* named in the dispatches, and it is believed that the commodore asked that he might be pardoned, but the State Department ignored the request; as they ignored any reference to him or any question about him.

Nolan and the Liberated Slaves

It was some eight years later that Nolan met with a situation which seemed the hardest that he had to bear. The boat upon which he was then voyaging came across a small schooner that had slaves on board. It was, at this time, against the law to bring any more slaves into the country, and so an officer from the American ship was sent to take charge. He was soon back, asking if anyone among the crew or passengers could speak Portuguese. Nolan offered his services.

When he boarded the dirty little schooner, he told the poor, bewildered negroes that they were free. They fell at his feet, kissed his hands, and cried out to him in broken voices:

"Tell them to take us home, take us to our own country, to our own houses, to our own babies and wives. We have not seen our home or heard of them in six months. Tell them to take us to Africa, our native land."

As Nolan told the American officer faithfully, word for word, he broke out in cold perspiration, and his face became gray. But he stuck to his post until he had interpreted to them what the white officer said, "Tell them yes, yes, yes; tell them they shall go to the moon if they will. If I have to sail this schooner through the desert, they shall go home."

Nolan could stand it no longer. His voice was silent, his throat dry and his eyes hot with suppressed tears. These poor African savages could go home, but he could not. He returned to his own ship and did not come out of his cabin for days.

He must have been nearly 80 when he died, a gentle, sad-eyed old man, who kept to himself a good deal, and whose face bore the marks of his punishment more plainly than if they had been cut in with a lash.

As he lay, knowing that he must die, he called into his cabin one of the men with whom he had formed some degree of friendship. To the man who entered it for the first time, the room was strange and startling. Above a crude picture of Washington, which Nolan had drawn, the Stars and Stripes were traced, with a great eagle poised over them. At the foot of his berth was a map of the United States as it was in 1805, beautifully drawn from memory. He had, of course, heard nothing of the progress of events during the time of his imprisonment, and the states admitted after that date were missing.

"Danforth," he said, "I am dying. I have surely been punished enough for the sin of my youth. Please tell me everything that has happened in the United States since I left."

As well as he could, Danforth told him all he knew, the old man's eager face shining as he listened. It was a long tale, for much had happened, but it was worth the effort for the happiness it gave.

"Look in my Bible when I am gone," Nolan said, when he had thanked Danforth again and again.

That night he died, and in his Bible they found this message, "Bury me in the sea; it has been my home, and I love it. But will not someone set up a stone to my memory at Fort Adams or New Orleans, that my disgrace may not be more than I ought to bear? Say on it:

In Memory of
Philip Nolan
Lieutenant of the Army of the United States.
He loved his country as no other man has loved her; but no man deserved less at her hands.

—*Retold from Edward Everett Hale's 'The Man Without a Country'.*

Hale, Nathan (1755-1776). In the dark days of 1778 after the retreat of the American army from Long Island, General Washington called for a volunteer to enter the British lines to secure information of the enemy. A young student of Yale College, 21 years of age, answered the call, and by so doing the patriot, Captain Nathan Hale, became a spy. His brother officers tried to dissuade him from the dangerous undertaking, but he felt that any service which his country needed was honorable.

He set out for the British lines in the disguise of a Dutch schoolmaster. He secured the information needed, and was on his way back to the American camp when he was detected, and arrested on Sept. 21, 1776. The papers in his shoes, as well as his own testimony, convicted him, and in accordance with military law General Howe ordered him to be hanged as a spy. The next morning the sentence was carried out, probably near the spot where a statue of him now stands in New York City. His last words are said to have been, "I only regret that I have but one life to lose for my country."

Halibut. The largest of the flatfish and the most important as a food supply. It is found in cold ocean waters and is caught by the same methods as the cod. Specimens five feet in length and 100 pounds in weight are frequently seen in the markets, and some halibut reach a length of ten feet or more. The halibut fisheries on the North Atlantic coast are rapidly being depleted and the chief supply for the United States is now brought by fast express trains from the Pacific. The name is derived from "holy" and recalls the halibut's use for food on holy days. (*See* Fish; Flatfish).

Halifax, Nova Scotia. The poet Kipling gave the name "The Warden of the North" to Halifax, the capital of Nova Scotia, because it is the greatest fortress and chief naval station of the British Empire in North America. It has occupied this position almost from the date of its founding by the British in 1749. When the English troops were driven out of Boston, in the first year of the American Revolution, they sailed away to Halifax to reorganize for the struggle. In the War of 1812 it was the base for the operations of British privateers, and during the American Civil War it became an important base for the Confederate blockade-runners. Many troops of

OVERLOOKING THE WATERFRONT OF HALIFAX

This view, taken from the roadway leading down from the citadel, gives a good idea of Halifax's wonderful harbor. About a mile wide and sixteen miles long, it has ample room and is well protected from storms. Twenty to thirty minutes' steaming takes a vessel from dock to the open sea. It was in this harbor that a French ammunition ship blew up in 1917, killing 2,000 persons.

both the United States and Canada sailed from Halifax during the World War of 1914–1918. On Dec. 6, 1917, a French vessel carrying a large cargo of munitions collided with a Belgian relief ship in the harbor, causing a terrible explosion and fire which killed 2,000 persons and devastated an area of about 2½ square miles on the north side of the city.

One reason why Halifax was so important during the war is that it is 600 miles, or about one day's steaming, nearer to England than the port of New York. It is also nearer to some ports of South America, and to South Africa, than several other northern ports of North America.

Its favorable position and its magnificent harbor make Halifax a great commercial center. Because of this the Canadian government has spent $30,000,000 improving the shipping facilities. It has built huge terminals where transcontinental trains can run alongside the great Atlantic liners.

Manufactures of importance have also grown up. Raw sugar is brought in from the West Indies and is refined in the largest refinery in Canada, an extensive oil refinery has been established, and foundries and machine shops make and repair equipment used by the great transportation companies. Population, about 60,000.

HALL OF FAME. On University Heights in New York City, on the grounds of the New York University, overlooking the Hudson River, is the "Hall of Fame for Great Americans." A colonnade 500 feet in length contains panels for 150 bronze tablets, each to bear the name of the person commemorated, the dates of his birth and death, and an appropriate inscription.

According to the conditions established by Helen Gould, the donor of the memorial, only persons who have been dead ten years or more may be so honored. Fifty names were to be inscribed at the beginning in 1900, and five names added every fifth year thereafter, until the full number is completed. Nominations made by the general public are received by the University senate, and those seconded by them are submitted to a committee of 100 prominent citizens, who vote upon them. All elections are subject to the approval of the University senate. If the full number of names is not chosen, the vacancies may be filled at the following election. In addition to statesmen, authors, artists, scientists, and educators, the 15 classes of citizens recommended for consideration include business men, inventors, engineers, explorers, philanthropists, and the like. A proposal of a separate hall for foreign-born Americans (later abandoned), and one for a Hall of Fame for Women, created some confusion in the voting. Only 29 instead of 50 names were offered in the first selection. These with later additions are given in the accompanying list.

GREAT AMERICANS ELECTED TO THE HALL OF FAME

CHOSEN IN 1900

George Washington
Abraham Lincoln
Daniel Webster
Benjamin Franklin
Ulysses S. Grant
John Marshall
Thomas Jefferson
Ralph Waldo Emerson
Henry Wadsworth Longfellow
Robert Fulton
Washington Irving
Jonathan Edwards
Samuel F. B. Morse
David Glasgow Farragut
Henry Clay
Nathaniel Hawthorne
George Peabody
Robert E. Lee
Peter Cooper
Eli Whitney
John James Audubon
Horace Mann
Henry Ward Beecher
James Kent
Joseph Story
John Adams
William Ellery Channing
Gilbert Stuart
Asa Gray

NAMES SUBSEQUENTLY ADDED

James Russell Lowell
John Greenleaf Whittier
John Quincy Adams
James Madison
Alexander Hamilton
William T. Sherman
Louis Agassiz
Maria Mitchell
Emma Willard
Mary Lyon
Harriet Beecher Stowe
Oliver Wendell Holmes
Edgar Allen Poe
James Fenimore Cooper
Phillips Brooks
William Cullen Bryant
Frances E. Willard
George Bancroft
John Lothrop Motley
Mark Hopkins
Francis Parkman
Elias Howe
Joseph Henry
Charlotte Cushman
Rufus Choate
Daniel Boone
Samuel L. Clemens (Mark Twain)
Augustus St. Gaudens
James Buchanan Eads
Patrick Henry
William T. G. Morton
Roger Williams
Alice Freeman Palmer
Andrew Jackson

HALLOWE'EN. Strange things may happen to one on Hallowe'en, so superstitious folk used to believe; for they thought that witches then rode abroad on broomsticks, elves played pranks on sober folk, and the future might be foretold by jumping over a lighted candle, or by any one of a hundred other magic rites.

Many of these strange superstitions have come down to us from our pagan ancestors of 2,000 years ago and more, for our Hallowe'en occurs about the time of the ancient Druidic autumn festival. This was also the season of the ancient Roman festival in honor of Pomona, the goddess of fruit and gardens; and so, after the Roman conquest of Gaul and Britain, some of the Roman beliefs and ceremonies were added. Later, after the spread of Christianity, November 1 was made a day for the honoring of all the saints, and the eve of that day was called "Hallowe'en" (or "All Hallow-Even"), meaning the "holy eve" of All Saints' Day. Many of the old pagan customs were retained, and so we still crack nuts, and bob for apples, and throw apple peelings over our shoulders, and look in a mirror by candle light in a darkened room, as our pagan ancestors did centuries ago.

HALS (*häls*), **FRANS** (1580?–1666). One of the amazing chapters in the history of art is that which tells how this Dutch painter, who is now recognized as one of the greatest portrait painters of all time, was almost forgotten and his work ignored for two centuries after his death. So slightly was he esteemed that some of his paintings were sold for a few dollars, though of late years as much as $125,000 has been paid for a single work by him. Critics today unite in putting him next to Rembrandt at the head of the Dutch school, and some even call him the greatest of all painters for truth of character.

Frans Hals had a checkered life, marked by the same bold contrasts of light and shade that are found in his work. Though of an ancient patrician family, the equal of the sturdy Haarlem burghers whose portraits he painted so profusely, Hals found the rollicking life of tavern and street more to his taste. Singers and jesters, pot-girls and tavern heroes—these were his favorite subjects; and he set them down on canvas with such an unquenchable humor and joy of living and so masterly a hand that no one can look at them without a responsive smile. But the painter's love of tavern life reduced him to penury, and near the close of his long life we find him so poor that he had to apply to the municipality for alms.

Born in Antwerp, Hals moved to Haarlem in Holland when he was a young man. In 1616 he began the first of the great series of shooting-guild groups and public officials that show his genius particularly well. In the Town Hall of Haarlem 84 ladies and gentlemen look down from the walls in eight great canvases. The last of the series was painted in 1661, when Hals was 81. There on the walls may be traced the artist's development. The picture painted in 1633 shows him at his most vigorous period, when his brilliant color and quick grasp of fleeting expression were at their height. The later groups are painted with great skill but the coloring has been toned down to somber gray tints. Does the grayness of these last pictures reflect the sadness of the poverty-stricken painter's declining years? Some hold to this explanation; others say that bright colors were so expensive that he had to use the cheaper black and white after his days of plenty were over.

THE GREATEST OF GERMANY'S SEAPORTS

We are looking across the Elbe River at Hamburg, during the days before the World War, when this was not only the largest German seaport, but the third most important harbor in the world. Although Hamburg is 75 miles from the sea, the largest vessels can come to dock here. The waterfront is six miles long, and is equipped with all the conveniences for loading, unloading and repairing vessels. Here, for instance, we see one of the many floating dry docks lifting a vessel bodily out of the water.

Many other examples of Hals's work are scattered throughout the world in public and private galleries. 'The Fool', a copy of which hangs in the Rijks Museum in Amsterdam, is considered by many to be the best character portrait ever painted. 'Hille Bobbe', an old woman with a half-witted grin, may be seen in the Royal Museum in Berlin. His best-known work is 'The Laughing Cavalier' in the Wallace Collection in London. The original owner paid $400 for it. Sir Richard Wallace paid $10,200 for it in 1865, and since then its value has increased greatly.

HAMBURG, GERMANY. Before the World War, Hamburg was the second largest city in Germany and the third largest seaport in the world, and presented a picturesque combination of life on land and water. Lying on the north bank of the Elbe River, 75 miles from its mouth, Hamburg bestrides a little stream called the Alster, which is here dammed, forming two lakes as harbors in the heart of the city. The older part of the town to the east is intersected by a great number of narrow canals, lined with warehouses and squat dwellings that seem to rise right out of the water. Barges and skiffs loaded with merchandise ply up and down these canals, and people may go and come from home to business in pleasant little steamers. Great sea-going vessels can come at high tide to the heart of the city and unload their cargoes into barges that distribute them as far inland as Prague in Bohemia. (*See* Elbe River).

Hamburg is a "city-state" with a republican form of government and a place in the German republic alongside of Bavaria, Saxony, and Prussia. The territory under its rule covers an area of about 160 square miles, including the outlying port of Cuxhaven at the mouth of the Elbe, with its tremendous system of docks and quays.

Viewed from the left bank of the Elbe, Hamburg and the adjoining Prussian town of Altona look like one city. With a continuous river frontage of six miles, crowded with shipping in normal times, and with its densely packed houses in the background surmounted by lofty church spires, the city gives an impression of massive grandeur. On the borders of the Binnen Alster, the smaller of the two lakes, are grouped fashionable avenues and the more important business streets, lined with magnificent buildings.

In the Hopfenmarkt, one of the largest public squares, stands the church of St. Nicholas (Nikolaikirche). Built as a memorial of the fire of 1842, it is the third highest religious edifice in the world, its spire soaring 483 feet above the street level. The new Rathaus is the most important of the secular buildings. The hospital at Eppendorf is one of the finest in Europe. Hagenbeck's private zoölogical gardens, which formerly contained the largest and most complete collection of wild animals in captivity, are also noted for life-size models of prehistoric monsters. The site of the city's old ramparts and fortifications has been converted into gardens and promenades of extraordinary beauty.

The History of Hamburg

Hamburg has its origin in a fortress and bishopric founded here by Charlemagne in 808–811. Its importance as a center of commerce began in the 12th century when Emperor Frederick I granted it free navigation of the Elbe, with the right of levying toll on foreign shipping. In 1241, it joined in the formation of the Hanseatic League and became the seat of its upper court (*see* Hanseatic League). This gave a tremendous impetus to its rapidly increasing wealth and commercial importance. In 1510 Maximilian I reorganized Hamburg as a free imperial city. Through its vigorous administration Hamburg suffered little from the Thirty Years' War, so fatal to other parts of Germany. Under Napoleon the French occupied it from 1806 to 1814.

Hamburg's modern greatness came in the middle of the 19th century with the development of great steamer lines to all parts of the world. Lying on the western side of the Danish peninsula, with an ice-free harbor all the year, it shared with Bremen the north Atlantic trade. A great part of its population, before the World War of 1914–18 paralyzed its industrial life, was engaged in shipping, shipbuilding, and allied occupations.

A great fire in 1842 destroyed one-third of Hamburg within three days; but this proved almost a blessing, since it resulted in a new city of wider streets and modern structures, a veritable Phoenix that rose from the ashes, statelier and more beautiful than ever. Area of the city-state, 160 square miles; population, about 1,200,000.

HAMILTON, ALEXANDER (1757–1804). Of all the men who aided in founding the republic of the United States, and in framing and setting up the government under the Constitution, the most brilliant was Alexander Hamilton. In spite of his youth (he was not yet 20 when the war began) he was one of Washington's most trusted aids in the Revolution; as a lawyer he ranked among the foremost of his time; in the critical period of 1783–89 he won recognition as one of the soundest political thinkers of the day; and in setting up the new Federal government he had the chief part in translating the lifeless provisions of the Constitution into a strong, national governing system. It is not too much to call him the greatest constructive statesman in United States history.

Hamilton's history was as unusual as the man himself. Born in the island of Nevis, in the British West Indies, he inherited from his well-born Scotch father shrewdness and a logical mind, while from his gentle Huguenot mother he received the liveliness and charm characteristic of the French. He early displayed a talent for writing, and his vivid description of a West Indian hurricane, which appeared in one of the local papers, so impressed his friends that they raised money and sent him to America to complete his education.

Hamilton's course at King's College (now Columbia University) in New York City was interrupted by the outbreak of the Revolutionary War. As early as 1774 he had begun to advocate the cause of the colonists; and as soon as the conflict began he entered the army, and was soon made captain. Then for four years (1777–81) he was on Washington's staff with the rank of lieutenant-colonel. He took a brilliant part in the field in the campaign which ended with Cornwallis' surrender. Washington felt for him the sincerest admiration and affection.

Even during the war Hamilton had seen the need for a strong central government; and during the critical period which followed, when the country was "floundering helplessly in a sea of unpaid debts and broken promises," he advocated the formation of a new constitution to take the place of the weak Articles of Confederation. He persuaded New York to send delegates to the Philadelphia Convention, and was himself chosen as one of the three to represent the state; but the other two were bitter Antifederalists and he was constantly outvoted until they withdrew from the convention. Then Hamilton signed the Constitution for New York. He believed that a limited monarchy like that of Great Britain was the best on earth, and failing that, he would have preferred a strong aristocratic republic, with the officers chosen for life. Nevertheless he exerted all his great powers in support of the Constitution that was formed. The opposition in his own state under Gov. George Clinton was very strong and without New York's ratification the Constitution could win no real success. So Hamilton, with the assistance of Madison and Jay, undertook to write a series of newspaper articles in its defense over the signature "The Federalist." Not only did these articles prove the decisive factor in securing New York's ratification, but they had a tremendous influence throughout the country. Although written only to serve a particular purpose in his own day, they have proved of great permanent value to students of law and political science, and are regarded as a classic commentary on the Constitution.

ALEXANDER HAMILTON

"The Greatest Constructive Statesman in United States history."

Washington appointed Hamilton as the first Secretary of the Treasury, and it was in this office that he left his strongest impress on the American government. It was he who at the outset gave the government under the Constitution its leaning toward strength and national unity on which Chief Justice Marshall was later able so effectively to build. His financial measures not merely assured the payment in full of the foreign and domestic debt of the United States, but also included the taking over by theUnited States of the debts contracted by the states as a result of the Revolution. The provision he carried through Congress only by a bargain which gave to the South the location of the Federal Capital on the Potomac. But the effect of the measure was not merely to restore the credit of the country, but to bind to the Union every holder of state and national "script" or bonds. Other important measures included the establishing of a national bank and the enacting of a tariff which should "protect infant industries." No American statesman ever had greater tasks to face than had Hamilton, and none was more successful in meeting them.

In his efforts to strengthen the national government Hamilton was opposed by Jefferson, Washington's Secretary of State, who was a firm believer in state's rights, and opposing views as to struggling France and England widened the breach. The two became the leaders of the first organized political parties of the United States—the Federalists and the Democratic Republicans (*see* Political Parties). Jefferson resigned from office at the close of 1793, and Hamilton a year later, but their party antagonism continued. In the election of 1800 Jefferson's party swept the country, but owing to a tangle of the election laws Congress was called upon to decide whether Jefferson or Aaron Burr should be president. Hamilton used his influence to defeat a plan of less scrupulous Federalists to substitute the vice-presidential for the presidential candidate of their opponents. Hamilton knew that the voters meant Jefferson to be their chief executive, and besides he profoundly distrusted Burr.

As a result of Hamilton's persistent opposition to him Burr finally challenged Hamilton to a duel. According to the accepted code of honor in his day, Hamilton could not refuse the challenge. On the morning of July 11, 1804, they met at Weehawken, a noted duelling-ground on the Jersey shore of the Hudson, opposite New York City. Hamilton did not intend to fire, but his opponent aimed with deadly precision. Hamilton fell mortally wounded, and died the next day. He was generally mourned by his countrymen; even those who differed from him politically were compelled to respect his great abilities and patriotism, and his untimely death was looked upon as a great public calamity.

HAMILTON, ONTARIO. Its location on an excellent harbor at the western end of Lake Ontario, and the cheap electrical power obtained from Niagara Falls, and the smaller Decew Falls, have combined to make Hamilton one of the foremost manufacturing cities of Canada. It has about 500 factories, which produce steel, iron, cotton and woolen goods, farm machinery, electrical supplies, stoves, furniture, and many other articles. Among the chief establishments are the Canadian plants of the International Harvester, Westinghouse, International Steel, and Oliver Plow companies. Hamilton is also the shipping center for the rich Ontario fruit district. Natural gas is obtained from the nearby Welland fields.

Hamilton is an attractive city, with its broad tree-bordered streets lined with residences and fine public buildings, which extend from the bay up the slope of "the Mountain," a continuation of the ridge over which the Niagara River flows to make Niagara Falls. Population, about 115,000.

'HAMLET'. By almost universal consent this is regarded as Shakespeare's greatest tragedy. The opening of the play reveals Hamlet, the young prince of Denmark, plunged in bitter grief by the sudden taking off of his royal father, who according to report had died of a serpent's sting. The fact that the queen, his mother, has almost immediately married the dead king's ill-favored brother adds to the Prince's sorrow. To him appears from the tomb the dread spirit of his father, revealing that, "sleeping, by a brother's hand" he had been put to death; and calls upon Hamlet to revenge this "foul and most unnatural murder."

Hamlet's brilliant, sensitive mind is thrown into feverish activity by the horror of this deed, yet he would make sure of his uncle's guilt. He feigns insanity, the better to watch the guilty pair, and in a court play has the actors insert a scene like that of his father's murder, that he may observe its effect on the usurping king. The latter's confusion confirms the ghost's revelation; but Hamlet, distracted between his duty of revenge and his inability to form a plan, contemplates his own suicide. "To be or not to be"—to live or die—he muses bitterly, "that is the question"—

> Whether 'tis nobler in the mind to suffer
> The slings and arrows of outrageous fortune;
> Or to take arms against a sea of troubles,
> And, by opposing, end them? To die: to sleep;
> No more; and, by a sleep to say we end
> The heartache, and the thousand natural shocks
> That flesh is heir to, 'tis a consummation
> Devoutly to be wished. To die, to sleep;
> To sleep: perchance to dream: ay, there's the rub;
> For in that sleep of death what dreams may come
> When we have shuffled off this mortal coil,
> Must give us pause. There's the respect
> That makes calamity of so long life;
> For who would bear the whips and scorns of time,
> The oppressor's wrong, the proud man's contumely,
> The pangs of despised love, the law's delay,
> The insolence of office, and the spurns
> That patient merit of the unworthy takes,
> When he himself might his quietus make
> With a bare bodkin? Who would fardels bear,
> To grunt and sweat under a weary life,
> But that the dread of something after death,
> The undiscovered country from whose bourn
> No traveller returns, puzzles the will,
> And makes us rather bear those ills we have
> Than fly to others we known not of?
> Thus conscience does make cowards of us all;
> And thus the native hue of resolution
> Is sicklied o'er with the pale cast of thought,
> And enterprises of great pith and moment
> With this regard their currents turn awry,
> And lose the name of action.

While Hamlet thus postpones revenge, the king resolves on Hamlet's instant death. Before he can effect it, Hamlet by accident has slain old Lord Polonius; whereupon the daughter of Polonius, Ophelia, a gentle girl with whom Hamlet is much in love, goes insane and drowns herself. Polonius' son, Laertes, swears hot revenge, and is thereupon ensnared by the king to carry out his own designs. A duelling match is planned with Hamlet, wherein Laertes, by the King's advice, shall use an untipped foil, poisoned at the point, while the king will furnish a cup of poisoned drink to quench Hamlet's thirst. In this tragic duel and end of the play, Hamlet is indeed slain as planned, but in the scuffle Laertes himself is pierced with his own envenomed sword. The queen by mistake drinks the poisoned cup and dies, and Hamlet in the instant of his death stabs the wicked king. About the only comic relief to the play is the dialogue of the grave-diggers who dig the grave of "the fair Ophelia."

HAMPDEN, JOHN (1594–1643). "Patriot" Hampden lives in history as one of the most gallant and determined of the band of Puritan statesmen who opposed the autocratic government of Charles I and brought on the English Civil War. He was a man of wealth and position, a cousin to Oliver Cromwell, and one of that leader's ablest supporters and advisers.

By refusing to pay the illegal ship-money tax levied by the king, Hampden became a popular hero and a central figure in the early stages of the Puritan Revolution. At his trial in 1637 seven of the 12 judges voted against him, but public opinion was in his favor and the opposition to the government was immeasurably strengthened. In the early days of the memorable Long Parliament (1640–60), Hampden was right-hand man to the redoubtable John Pym, then leader of the Puritan cause, and was one of the five members whose attempted seizure by King Charles on Jan. 4, 1642, lead rapidly to armed conflict.

When hostilities began, Hampden joined the parliamentary army, contributed liberally to its support, raised a regiment of infantry, and in the struggle displayed great bravery and generalship. He was mortally wounded at Chalgrove Field, June 18, 1643, and died June 24. Such was his capacity as a statesman and a soldier that the historian Macaulay has said that, if he had lived, he would have been "the Washington of England."

HANCOCK, JOHN (1737–1793). The name of this Boston patriot, written in a large bold hand, heads the list of the signers of the Declaration of Independence. From this circumstance came the common phrase, "to give one's John Hancock," meaning to sign one's name; and from it also the name of John Hancock has gained an enduring fame, which his actual importance scarcely warrants.

John Hancock did, however, play a considerable part in the events leading up to and following the Revolution. He was a wealthy Boston merchant, and in 1768 the royal commissioners of customs provoked a riot by attempting to seize his sloop, the *Liberty*, for non-payment of duties. If the government was able to collect in this case, it could also collect for previous importations, and Hancock, along with other merchants, was threatened with ruin. In part, his opposition to the Crown was no doubt due to this business interest; and it is said that, when his interest required, he violated the non-importation agreements of the colonies and imported a good deal of tea from England.

But whatever Hancock's motives may have been, from 1768 on he was active in his opposition to the British Crown. In 1770, after the "Boston Massacre," he was one of the committee that went to the governor to demand the removal of British troops from the city, and at the funeral of the victims he delivered an address which led to an order for his arrest. He was president of the revolutionary "Provincial Congress" which met at Concord and later at Cambridge, and his arrest was one of the objects of the British expedition to Concord which precipitated the battle of Lexington and Concord and began the Revolutionary War.

Hancock was elected president of the Second Continental Congress in 1775 and held that office two years. In 1780 he became the first elected governor of Massachusetts, and was annually re-elected, with an interval of two years (1785–1787), until his death. The support which he was finally induced to give to the Federal Constitution in 1788 was the decisive factor in the struggle for ratification in Massachusetts, and in setting the new plan in operation.

Despite the jealousy and vanity which limited his work, Hancock was a man of strong common sense and sound patriotism, and it meant much to the cause of the colonies to have the support of his wealth, social position, and education, when many of the upper class were Loyalists, or "Tories," as their enemies called them.

Hancock, Winfield Scott (1824–1886). One of the best all-round soldiers among the Union officers of the Civil War was Winfield Scott Hancock. He received his military training at West Point, graduating in 1844, and gained experience in the War with Mexico. He was a captain when the Civil War broke out, and was soon commissioned brigadier-general and helped to organize the Army of the Potomac. He did gallant service in the battles of South Mountain and Antietam (1862). At Fredericksburg (December 1862) he led his corps in a desperate attack on Maryes' Height through a deadly fire, from which less than 3,000 of the original 5,000 came back. At Gettysburg (1863) it was said that his appearance on Cemetery Ridge on the first day of the battle was equal to reinforcement by an army corps. Men who were fleeing stopped and the troops were restored to order.

General Hancock was in command of the Second Corps, and it was his forces which, on the last day of the battle, stopped the terrible charge of Pickett's men and deprived the South of all hope of victory. During this attack Hancock was seriously wounded, but he stayed on the field until the victory was won. After he recovered from his wounds, he bore an important part in the hard-fought battles of the Wilderness, Spottsylvania, and Cold Harbor, in 1864. At Spottsylvania he carried the Confederate works known as "the bloody angle," capturing 3,000 prisoners. For his notable services Hancock was promoted to the rank of major-general in 1866.

In 1880 the Democratic party made him their candidate for the presidency, but in the election he was defeated by James A. Garfield, who in addition to an honorable military career had long been a leader in Congress. Hancock remained in the army until his death, serving his country for over 40 years. He was a brave fearless leader and an able commander. McClellan called him "superb," and Grant wrote: "Hancock stands the most conspicuous figure of all who did not exercise a separate command."

Hand. Whatever men have done that distinguishes them from the brutes has been done by their brains. But the hand has been the instrument of the brain in bringing about almost all of these successes. The cultivation of the soil, mining, building, manufacturing—sculpture, painting, literature—what could man have done without his hands? Can you imagine this book to be written, printed, bound, and distributed without hands? Apart from the hand, speech is the only important instrument of the brain that distinguishes man from the lower animals.

The human hand is indeed a wonderful piece of mechanism. Placed at the end of the arm, with the ball-and-socket joint at the shoulder, the hinge joint at the elbow, and a peculiar joint at the wrist, the movements of the hand are indeed marvelous.

The eight bones of the wrist are called "carpal" bones, the five of the palm are the "metacarpals," and the 14 in the fingers are the "phalanges." These phalanges are so called because they are arranged in ranks, as were the Greek soldiers in the military formation known as the "phalanx." All these bones are bound together by tough flexible ligaments.

The muscles that move the hand are mostly upon the forearm, and have long tendons by which the pull of the muscles is communicated to the different joints. You can feel and see some of these tendons in your wrist when you bend your fingers. There are more than 30 pairs of muscles producing hand motions.

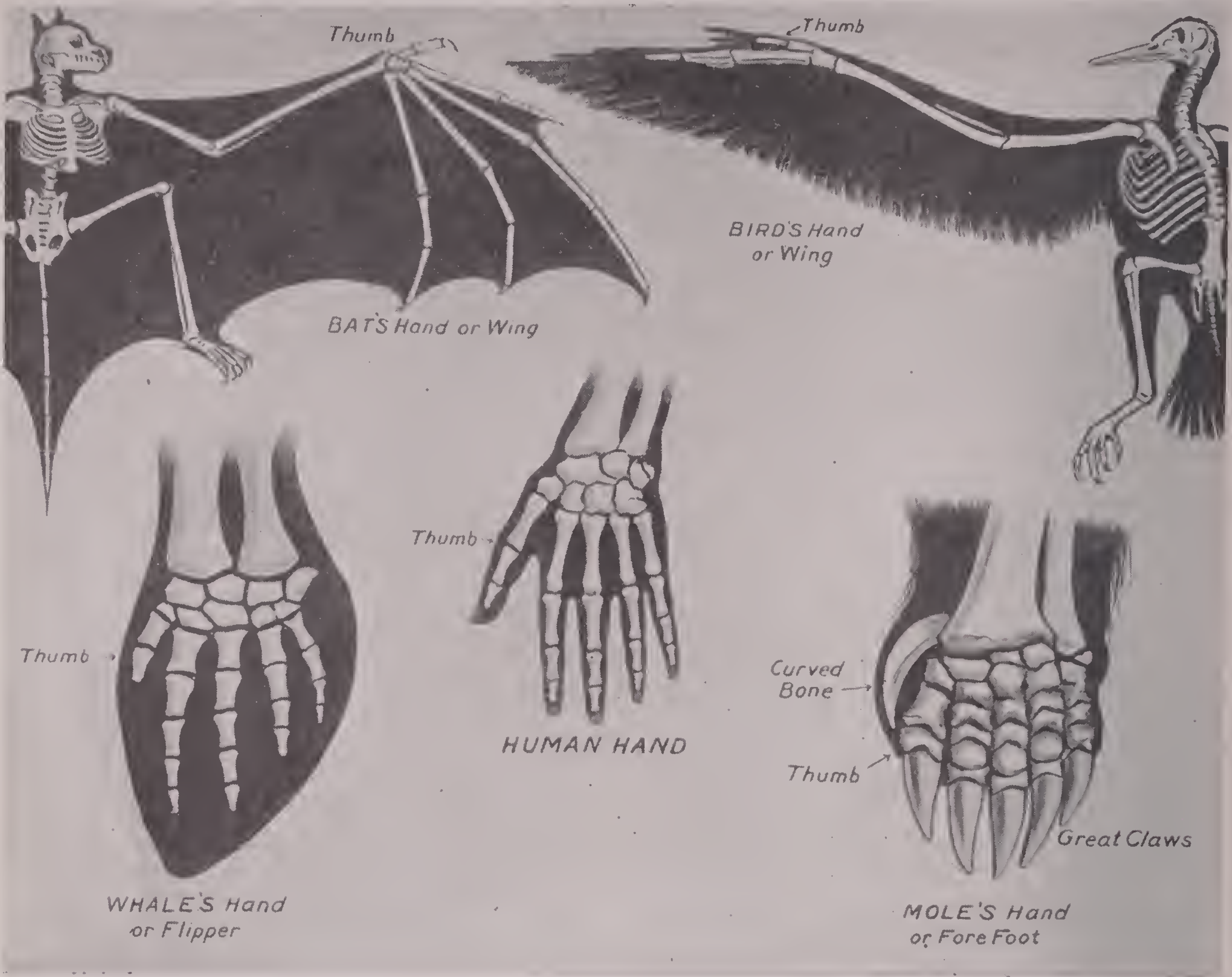
The thumb is arranged so as to work against the fingers in very useful grasping movements. Just "make believe" that you have no thumb and try to pick up something or to write or to use a fork!

The sensibility of the hand is more highly developed than in most other parts of the body. There are many little elevations or *papillae* on the skin of the palm, and fine nerve fibers extend from these to the brain. Thus the skin is made very sensitive to touch, heat, and cold.

Because it possesses both strength and lightness of touch, the hand is wonderfully adaptable to all sorts of uses. The flexible fingers can grasp large objects firmly and manipulate delicate machinery, while the nails on the tips make it possible to pick up very small things. The same hand that wields the hammer may adjust the minute parts of a watch. The lightning-like rapidity with which trained finger muscles can perform tremendously complicated tasks, such as the fingering of violin strings by a Kreisler or the rippling of piano keys by a Paderewski must always seem a miracle to the ordinary man.

While the human hand is the most completely developed in the animal kingdom for all-round purposes of protection, strength, blows, grasping, delicate movements, and sensitiveness, it is interesting to note that the fore limb of all mammals is formed on the same general plan. The horse's front hoof is just a modified finger nail; all the fingers but one have disappeared or are represented only by the remnants called "splints." In these animals the modifications

"HANDS" FOR FLYING, SWIMMING, DIGGING, AND GRASPING



While the Human hand is the most perfect instrument of all, other creatures also have "hands" adapted to various purposes. The fingers of the Bat, as you can see, have grown very long to support his wings, the "thumb" remaining free to be used as a clinging hook. The Bird's "hand" has lost almost all its fingers, stiff feathers taking their place. The Whale's hand is broad and short, but all the fingers are plainly represented. The Mole not only has the usual five digits, but also an extra bone to make his digging palm even broader, and his "finger nails" have developed into huge claws.

are for purposes of speed in running. In the bat, very long fingers are developed to support the web which, instead of feathers, constitutes the "wing" in those flying mammals. The beaver's hand has a still different form, adapted to its mode of life. The mole has a broad shovel-shaped hand. Even the whale has a fore limb which has the modified structure of a hand.

HAN'DEL, George Frederick (1685–1759). The name Handel suggests Christmas and the 'Messiah', for this oratorio of his has for so many years been given in connection with the holiday festivities that it has come to be a tradition of the season.

Although Handel was born a German, he won his first great fame in Italy with his Italian operas. He later became an English citizen, and is today chiefly remembered for his English oratorios.

The father of Handel, a German doctor of Halle, was much opposed to his son's musical ambitions. But the boy was obsessed with a desire to learn to play the spinet (an early form of the piano); and at the age of eight years had so taught himself that when an opportunity was presented for him to play the organ in the castle of a neighboring duke, he did it so skilfully that the duke persuaded the lad's father to give his son a musical education. The boy at once became a pupil of the organist of the Halle cathedral.

At the age of 11 he was master of the organ, clavichord, violin, and other instruments, and was proficient in musical composition. When 20 years of age he produced his first opera, which was favorably received. He went to Italy to study the Italian style of opera, and there his brilliant performances on the harpsichord won his highest recognition.

Handel next went to London, where his triumph was repeated. England offered so much in the way of opportunity and appreciation that when 41 years of age Handel became a naturalized Englishman. Seven years later he began his career as an English composer, using from that time only English texts for his oratorios. To these his greatest fame is due.

A KING'S TRIBUTE TO HANDEL'S MUSIC

Although the English public of his day had come to expect great things of Handel, none were prepared for such glorious musical effects as those obtained in his oratorio 'Messiah'. When presented by a mighty chorus and superb orchestra, the masterpiece took England by storm, and led to as graceful a tribute as has ever been given music by royalty. King George I, swept away by enthusiasm during the earlier portions of the work, rose to his feet and stood during the performance of the 'Hallelujah Chorus' and thus created the custom, which still exists, of standing during this portion of the oratorio. Handel was so impressed with the reception given his work in England that he gave up his German citizenship and became a naturalized Englishman.

Other musicians were composing operas, but English oratorio, as composed by Handel, was an innovation. The English people loved his music, and the royal family were always his staunch supporters. Handel grew old, blessed by the comfort of his music and many friends. The bitterest trial of his life came in his later years, when he became totally blind. Yet, he still played and conducted his oratorios.

Handel will never cease to be revered as one of the greatest of composers. Besides his 18 English oratorios, his works include 41 Italian operas, 2 Italian oratorios, 4 English secular oratorios, 3 volumes of English anthems, 1 volume of Latin church music, 3 volumes of Italian vocal chamber music, 37 instrumental duets and trios, and 4 volumes of orchestral music and organ concertos.

HANDWRITING. Every boy and girl is ambitious to "write a good hand" and to do this rapidly. Success in obtaining and in holding a business position often depends upon the candidate's penmanship. Hence these suggestions in regard to handwriting should be carefully considered.

Learning to write is an example of the development of manual skill, and the general principles of this sort of learning apply to it. The most important principle is repetition. We learn to make a new movement by the "trial and error," or the "cut and try," method. Nobody can tell the beginner just how to do it; he has to learn for himself. Furthermore, he cannot learn for himself by thinking it over and theorizing about how it should be done. He must try over and over again, each time trying to do it a little better.

Mere repetition, as is implied in the last sentence, is of no use. One may write a great deal and still write continually worse. The pupil, while he is practicing, must continually observe his writing closely, compare it with former specimens of his writing, and with a model which is superior to his own.

In practice a balanced emphasis should be placed on the two aspects of speed and quality. Both speed and quality should be moderate in the beginning, and should improve together. Over-emphasis on speed produces a scrawl, and over-emphasis on quality or form produces labored writing, which is apt not to be so good, even in form, as more fluent writing. As practice is prolonged, the writing becomes automatic. It may be carried on while the attention is chiefly occupied with something else. Writing should not become automatic before the quality is sufficiently good, nor should automatization be put off after this point has been reached.

The kind of drill in writing should be carefully adapted to the age and maturity of the learner. It is well for the beginner to write for several months on the blackboard alone. The large free movement of the whole arm at the board is much easier to control than the more delicate movement of the pen or pencil. When the child first writes on paper he should use a soft smooth pencil, and should write a coarse hand on large sheets of comparatively rough paper. The pen may be introduced in the third grade. Intensive drill on minute details of form should be deferred until the fourth grade or above.

The ease and quality of writing depends a good deal on position. The writer should face the desk squarely and rest both arms on it lightly for about three-quarters of their length. The paper should be directly in front of the writer, with the top tilted about 30 degrees to the left. The pen should be grasped lightly, and the hand held with the palm pretty well down and sliding easily on the nails or the first joints of the last two fingers. The writing should be carried on with a free, easy, rhythmical movement, which may be developed with the aid of counting. It is important that the hand move freely to the right while the letters are being formed.

The very strongly left-handed writer should not be forced to use his right hand. For him the position of the paper should be reversed, and he may be allowed to write back-hand.

HANG'CHOW, CHINA. When Marco Polo, the greatest of medieval travelers, visited Hangchow near the end of the 13th century, he was so transported with the number and splendor of its mansions and the wealth and luxury of its people that he declared it was the finest and noblest city in the world. It still ranks as one of the richest cities of China, though it lost much of its ancient magnificence when it was laid in ruins by the Taiping rebels in 1861. Its shops are noted for their size and the excellence of their stocks, and its manufactures of silk, paper fans, tapestries, ivory carvings, and lacquered ware are world famous.

Hangchow, which is about 100 miles southwest of Shanghai, lies near the head of the estuary of the Tsien-tang River, 50 miles from the ocean. Although the river is visited at certain seasons by destructive "bores"—great tidal waves 15 feet high which rush up-stream at the rate of 15 miles an hour—it is constantly crowded with small craft which transport vast quantities of merchandise to and from the southern provinces. An immense amount of traffic is also carried by the Grand Canal, which ends here.

Just outside its massive walls, 12 miles in circuit, lies the famous Si-hu or West Lake, which travelers account one of the most charming scenes in China, with swarms of gaily painted boats plying between the villas, shrines, and monasteries which line its banks and cover the many small islands. Tens of thousands of pilgrims daily visit the splendid Buddhist temples near by. Since 1896 Hangchow has been opened to foreigners for trade and residence. From the 10th to the 13th century it was the capital of southern China. Population, about 685,000.

HANKOW', CHINA. Six hundred miles up the Yangtze from Shanghai lies the Pittsburgh of China —Hankow. Its waterfront, on the north bank of the Yangtze, is a long straight stone-paved *bund*, half a mile wide and exceedingly busy. Facing it are the pretentious buildings of the foreign concessions which look out across a broad, carefully kept, tree-lined boulevard where an endless procession of men, women, and children travels afoot to and from the yellow surging river choked with traffic—gunboats, steamers, tugs, lighters, junks, sampans. Here is the center of Hankow's commerce in tea and iron.

Threading your way through streets filled with wheelbarrow drays and pedestrians, so narrow that single file is necessary, you soon sight the countless smokestacks of the Hanyang Iron and Steel Works, destined perhaps to become one of the greatest producers of iron and steel in the world. It is on the other side of the river, and the Han, which here joins the Yangtze, must be crossed in a sampan.

The mills own and operate their own coalfields, 290 miles up the river, with an estimated yearly capacity of 1,000,000 tons for 500 years; and ore deposits, 70 miles down the river and 17 miles inland, with an estimated capacity of 1,000,000 tons yearly for 100 years. Both coal and ore come to the mills by water transport. Twenty thousand Chinese work here, at 10 cents per day for unskilled and from 30 cents to 50 cents for skilled labor. Other industries are cotton, hemp, and flour mills, and tanneries. Oil is stored in great tanks for distribution. The city is an important point on the railroad between Peking and Canton. More or less modern machinery is used in these plants and some of them are under foreign management and have foreign capital invested in them. The population of the Hankow-Hanyang-Wuchang triple city is about 1,500,000.

HANNIBAL (about 247–183 B.C.). "I swear that so soon as age will permit, I will follow the Romans both at sea and on land. I will use fire and steel to arrest the destiny of Rome." The boy Hannibal stood at the altar beside his father, the great Carthaginian general Hamilcar Barca, and repeated this solemn oath of enmity against his country's powerful rival. The warrior and his young son were setting out together for Spain, where Hamilcar hoped to gain conquests that would compensate Carthage for the possessions that Rome had wrested from it in the disastrous war recently ended—the First Punic War. He was taking Hannibal with him that he might learn the ways of war and prepare to renew the death-struggle with Rome for the supremacy of the Mediterranean.

So well did Hannibal learn his lesson that after his father's death he succeeded to the command of the army in Spain, and three years later (218 B.C.) was prepared to renew the contest to which he had been dedicated. While the Roman senate was planning to invade the Carthaginian domains, Hannibal was already starting on the most daring march known to the ancient world.

Along the eastern coast of Spain, over the Pyrenees Mountains, and across the swift waters of the Rhone, he led his forces of 50,000 foot soldiers, 9,000 horsemen, and scores of elephants. It was already autumn and the cold was intense when this band, accustomed to the sunny lands of Africa and Spain, began to cross the perilous Alps. Blinded and almost overwhelmed by snowstorms, over steep and narrow paths they struggled, cheered and encouraged by their dauntless leader. In places the natives rolled heavy stones down the mountain sides upon them; many men slipped down the icy precipices and were killed; others perished of cold, hunger, and exhaustion, so that the army was reduced to less than half its original number when it descended upon the plains of northern Italy.

By the skilful use of his cavalry, in which the Romans were weak, Hannibal won two great victories, at the Trebia River and at Lake Trasimene. Alarmed at these disasters, which had shattered one army and nearly destroyed another, the Romans appointed a dictator—an official invested with extraordinary power. Their choice fell upon a wise statesman named Quintus Fabius Maximus. Instead of risking an engagement at once, Fabius adopted a policy of following the Carthaginian army, delaying it and harassing it in every possible way. From this he was nicknamed *Cunctator*, or "delayer," and even to this day cautious generals who practice similar tactics are said to pursue a "Fabian" policy.

At last, in the summer of 216 B.C., a Roman army of between 70,000 and 100,000 met Hannibal's band at Cannae, near the southeastern coast of Italy. Though far outnumbered, Hannibal managed by clever strategy to surround the forces of his enemy and annihilate them. Ex-consuls, senators, nobles, thousands of the best citizens were among the 60,000 slain. Of the gold rings which they wore as an indication of their rank, Hannibal is reported to have sent a bushel to Carthage.

Won a Great Battle but Lost the War

But the victory bore little fruit, for Hannibal was one man fighting against a nation. He failed to receive support either from his own countrymen or from the Italians that he subdued during the 15 years that he remained in Italy. His brother Hasdrubal, coming to his aid with reinforcements from Spain, was met by a Roman force, completely defeated, and slain. His severed head was hurled into the camp of Hannibal, who anxiously awaited him. Still Hannibal struggled on, until a Roman army under Scipio Africanus invaded Carthage and he was forced to return home. At Zama in his own country, the lion-hearted commander who for 15 years had ravaged Italy suffered a crushing and final defeat. The long battle for supremacy was ended and Rome was mistress of the Mediterranean.

Hannibal now showed that he could be a statesman as well as a soldier. Elected chief magistrate, he reformed and strengthened the government of Carthage and contrived to pay, without hardship to the people, the heavy tribute exacted by Rome. The Romans, alarmed by this prosperity and by the charges of his enemies that he was plotting to renew the war against Rome, demanded Hannibal's surrender. To avoid falling into their hands, he fled to Asia, and when several years later the Romans hunted him out, he took poison, which, we are told, he always carried with him in a ring.

So died one of the greatest and most gifted military leaders of ancient times; an ardent patriot, a crafty strategist, and the most formidable foe that ever threatened the Roman Republic at the height of its power. (*See* Carthage.)

HANOVER, GERMANY. For about 120 years the kings of Great Britain were also German princes, ruling the kingdom (formerly electorate) of Hanover in northwestern Germany. This state of things lasted from the accession of George I, the first of the Hanoverian (or Brunswick) dynasty, in 1714, until the death of his great-great-grandson, William IV. Owing to a law forbidding female succession in Hanover, that land passed to another ruler when Queen Victoria ascended the British throne in 1837. In the war between Prussia and Austria, in 1866, Hanover was allied with Austria, and victorious Bismarck thereupon annexed it to Prussia, of which it still remains a part. The area of this Prussian province is now 14,862 square miles, and its population about 3,000,000.

The city of Hanover, the capital of the province about 60 miles southeast of Bremen, contains an irregularly built "old town," with many quaint stucco-front houses, and handsome new quarters to the north and east. There are many fine parks, picture galleries and museums, a palace with magnificent decorations, and other fine buildings. Numerous manufactures—hardware, chemicals, machinery, linen, tobacco, etc.—have contributed to the city's rapid growth in the past half-century. For many years foreign students—especially English—studied in Hanover, on account of the reputed purity of the German spoken there. Population of the city, about 300,000.

HANSEAT'IC LEAGUE. A fleet of tall-masted ships met in the sound off the coast of Denmark in the spring of 1368. They came from the cities of northern Germany belonging to the Hanseatic League, which was at war with the king of Denmark. For two years they harassed the Danish coasts and waters, sacked Danish cities, and plundered their treasures. At the end of that time the king of Denmark was glad to make peace, although the terms exacted were most humiliating. The cities of the League demanded a share in the Danish revenues for 15 years, the possession of Danish strongholds, and the final voice in the selection of the Danish kings.

This episode in the history of the loose confederation of North German cities known as the Hanseatic League gives an idea of the power it then possessed. It had been growing up gradually. No one knows just when it began. More than a hundred years earlier cities had formed alliances or "hansas" to protect their traders from the plundering barons along the highways and the pirates upon the seas. These alliances proved so useful that gradually more towns joined the strongest league, of which Lübeck was the center, and this union became known as the Hanseatic League.

Just how many towns were in the league no one knows. Even its ambassadors in London, when asked for the number of towns, scornfully replied that they could not be expected to know all the places, large and small, in whose name they spoke. At the height of its power in the 14th century it probably contained nearly 100 cities, extending from Dinant in Belgium to Cracow in Poland, and its "factories" or trading-posts stretched from the "Steelyard" in London to the "Court of St. Peter's" in the faraway city of Novgorod, Russia.

In these foreign factories the representatives of the league lived almost like monks. They were forbidden to marry as long as they remained abroad. They could not leave the factory at night. Iron doors, savage dogs, and watchful guards were provided to enforce this rule. They could not associate with the people of the country except for business purposes, and they were required to be rigidly honest in their dealings, for the dishonesty of one would bring the wrath of the townsmen upon all.

But the advantages more than balanced these restrictions. Merchants of the league were exempt from the taxes and tolls levied upon others. And in some places they had a monopoly of a certain trade, as of the herring fisheries off the coast of Sweden. At the height of its power the league not only protected its merchants but also maintained its fleet and even engaged in war to safeguard its interests. It played an important part in suppressing lawlessness, in carrying comforts and conveniences into half-barbarous lands, and in promoting enlightenment and civilization throughout northern Europe.

But quarrels between the towns gradually weakened the influence of the league, for it was only a loose union whose assembly met every year or two, but had no authority to enforce its decisions. The rise of strong political states such as Denmark created rivals and enemies for the Hansa. The discovery of America and of the route around Africa lessened the commercial importance of most of the North German cities. But the death-blow to the league came when the herring suddenly deserted their haunts off the shores of Sweden for the coast of Holland. The exclusive control of the herring fisheries had been the most highly prized privilege of the league, and with that gone the members lost interest. By 1630 most of the towns had deserted the alliance, but the free cities of Hamburg, Lübeck, and Bremen continued to be known as Hansa towns until the latter part of the 19th century (*see* Bremen; Hamburg).

HAPSBURG. On the top of the Wülpelsberg (1,682 feet high), in northern Switzerland near the junction of the little river Reuss with the Aar, stands the ruined "Hawk's Castle" (*Habichtsburg*) which

WHEN HANNIBAL CROSSED THE ALPS

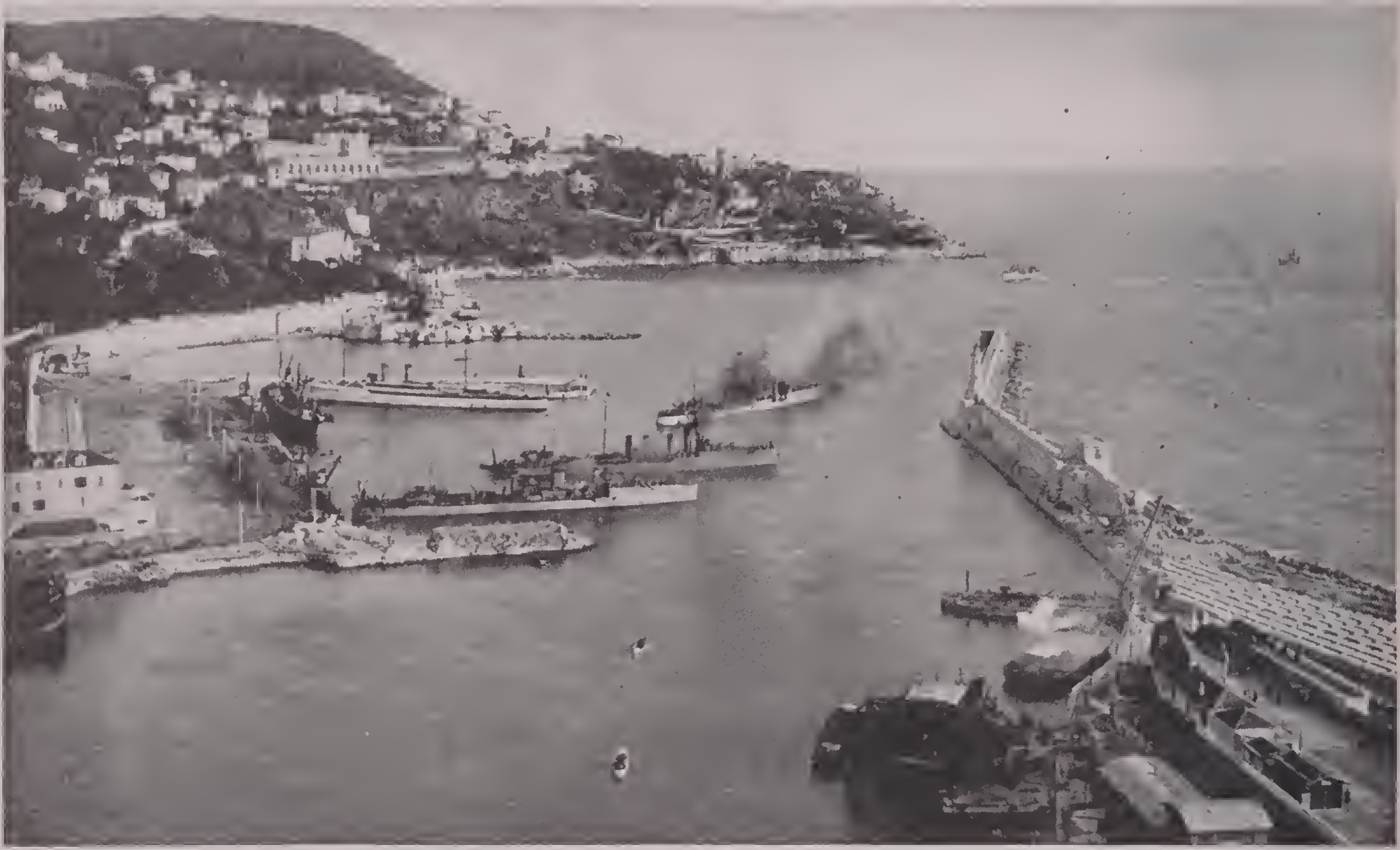
Here stands Hannibal, with members of his staff, directing the passage of the Carthaginian army over a dangerous spot, in the famous march from Spain across the Alps to Italy. Beset by hostile natives, exposed to the rigors of an Alpine winter, with insufficient food, and without anything approaching modern means of transport, the task of Hannibal's army was stupendous. The success with which this seemingly impossible enterprise was carried out is still a marvel to military men.

was the original seat of the famous Hapsburg (or Habsburg) family. The castle was erected in 1020, and its owners ruled Austria from 1278 to the end of the World War. With the exception of one reign (Charles VII, 1742–1745), all the rulers of the Holy Roman Empire from 1438 until the abolition of the empire in 1806 were members of the Hapsburg house. The Emperor Charles V (1519–1556) was by descent on his father's side a Hapsburg (*see* Charles V, Holy Roman Emperor). After the division of his dominions there were two Hapsburg houses, the one ruling Spain until the extinction of the line in 1700, and the other in Austria until 1918. A very full lower lip and a long pointed chin—the famous "Hapsburg chin"—became family features after a marriage with a Bohemian princess in the 15th century. (*See* Austria-Hungary.)

Harbors and Docks. The destiny of nations is largely controlled by their coast lines. Commerce, with the progress in civilization which follows on its heels, most readily springs up where there are well-sheltered harbors in which ships may safely load and unload their cargoes. Despite its vast potential wealth, Africa, with the exception of the narrow strip along the Mediterranean, remained undeveloped until the 19th century largely because it has so few natural harbors. On the other hand, the civilization we enjoy today was born in the Mediterranean lands, where many safe harbors tempted men to traverse the sea and interchange products and ideas. One of the controlling factors in bringing about the differences between the "unchanging East" and the changeful West has been the abundance of harbors in Europe and their comparative scarcity in Asia. The importance of harbors is particularly noticeable in the history of North and South America, for nearly all the early centers of settlement were at some bay or river mouth which afforded shelter to the vessels of the first arrivals.

Immense sums have been spent to improve natural harbors or to construct artificial ones. Tremendous breakwaters and jetties have been built far out into the sea to break up heavy seas and afford a safe refuge. Other jetties have been built to narrow the channel and increase the scouring effect of the current, thus deepening the water. Constant dredging is necessary in many harbors to remove the sand and silt deposited by tides and rivers. At London, Liverpool, Havre, and many other tidal harbors immense "wet docks" have been built, with miles of basins to which ships are admitted by gates that retain the waters when the tide runs out.

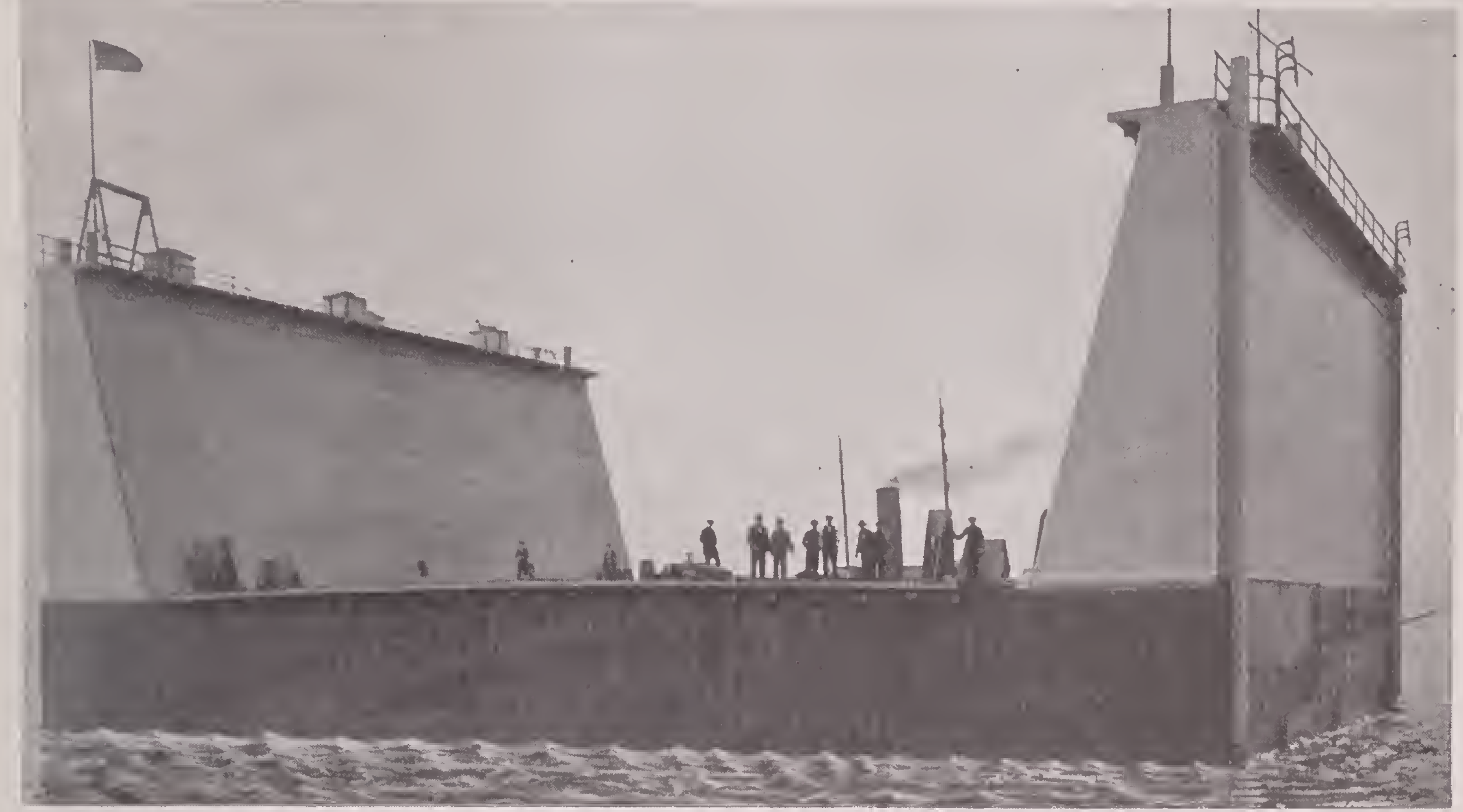
HELPING NATURE PROVIDE A HARBOR FOR MARSEILLES



This picture of the entrance to the so-called "old harbor" of Marseilles shows how artificial works are used to improve natural harbors. Although the land-locked bay provides good shelter for vessels riding at anchor, the French engineers have erected breakwaters to break the force of the waves across the harbor's mouth and dredged basins in order to let big ships come alongside the docks. The ships we see here are mostly French naval vessels.

In many cases river channels have been dredged deeper or canals have been built to turn inland cities into harbors which receive ocean-going vessels. Perhaps the leading example is the city of Manchester,

A FLOATING HOSPITAL FOR SHIPS



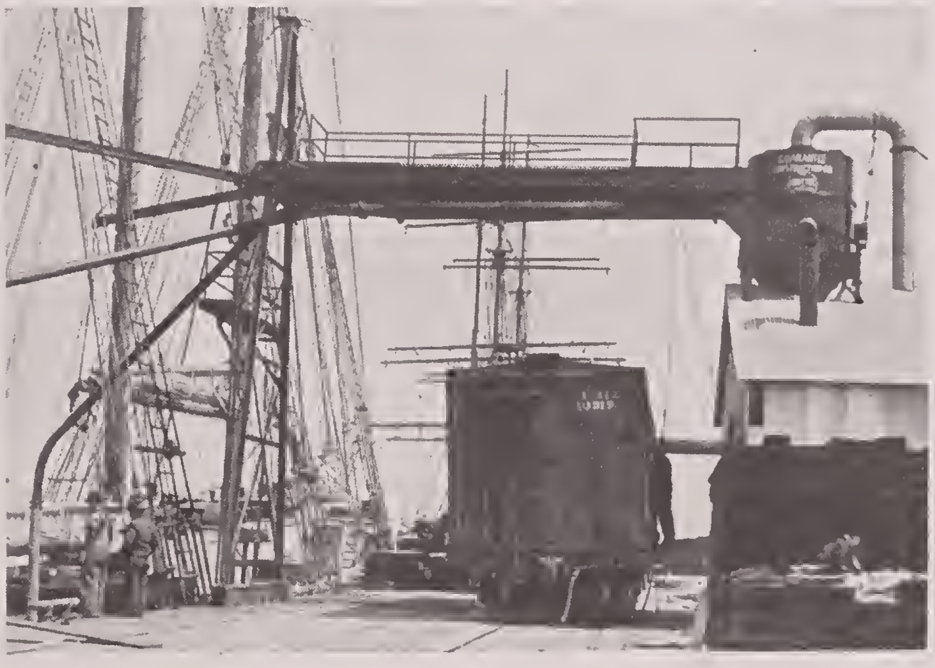
Here is a section of a great floating dry-dock, of the type used to hoist large ocean-going vessels out of the water, so that repairs may be made upon their hulls. When a vessel is to be raised, several such sections are brought together, and water is admitted to the space between their walls until their "floors" sink below the surface. The ship then moves in between the sides of the dock, and the water is pumped out again from the hollow walls, raising the hull clear of the waves. Long supports or "shores" are thrust out, of course, from the sides to keep the vessel from tipping over in its berth during this process.

England, which is connected with the ocean by the Mersey River and the famous Manchester Ship Canal, 35 miles long, allowing steamers to unload cargoes from foreign ports in the Manchester docks. Another notable instance is the port of Hamburg, 75 miles from the sea. Continuous dredging has deepened the channel of the Elbe from 15 feet to about 40 feet, so that the largest steamers can ascend it. Its vast harbor was almost all made by excavation.

Among harbor improvements are also included the extensive warehouses for storing freight while it awaits transportation. Even more important is the need for quick and easy shipments between the seacoast and the interior of the country. This usually takes the form of railroad tracks leading down to the dock, so that freight may be transferred directly from ship to car or from car to ship.

All great harbors are equipped with facilities for repairing ships, chief of which are "dry-docks." These consist of large basins, now usually built of concrete, which can be closed with water-tight gates after a vessel has entered. The water is then pumped out, or allowed to run out with the tide, the ship being held upright by "shores" or supports, while workmen scrape, mend, or paint the hull. Floating dry-docks are sometimes used in place of stationary dry-docks. These consist of great pontoons of wood or steel, forming a bed for the ship. When the pontoons are filled with water, the ship floats in above them; they are then pumped out, raising the ship clear of the surface.

A MODERN SYSTEM FOR UNLOADING



The machinery on the dock is transferring copra (dried cocoanut kernels) directly from the hold of the schooner to the freight car on the track. The pneumatic tubes on the left draw up the copra, carry it over the "bridge" and deliver it into the car from the right. The building contains the pumps which provide the suction.

In the WHITE HOUSE *after the* WORLD WAR

> *"MUCH has been said of late about world ideals, but I prefer to think of the ideal for America. I like to think there is something more than the patriotism and practical wisdom of the founding fathers. It is good to believe that maybe destiny held this New World republic to be the supreme example of representative democracy and orderly liberty by which humanity is inspired to higher achievement. It is idle to think we have attained perfection, but there is the satisfying knowledge that we hold orderly processes for making our government reflect the heart and mind of the republic. Ours is not only a fortunate people but a very common-sensical people, with vision high but their feet on the earth, with belief in themselves and faith in God. Whether enemies threaten from without or menaces arise from within, there is some indefinable voice saying: 'Have confidence in the republic! America will go on!'"—Speech of Acceptance, July 22, 1920.*

HARDING, WARREN GAMALIEL (born 1865). Few presidents have come into office with a more difficult task confronting them than that which faced the 29th president of the United States on his inauguration, March 4, 1921.

In the first place, owing to party differences the Versailles peace treaty, in the negotiation of which President Wilson had taken part on behalf of the United States, had failed of ratification in the Senate. This left the United States technically in a condition of suspended warfare with Germany and Austria and with no share in the new League of Nations—which, indeed, had been the chief stumbling-block to the ratification of the peace treaty. Friends of Germany and Austria were resentful at the harsh terms imposed upon those countries; an irreconcilable group of Republican senators demanded the complete "scrapping" of the League of Nations covenant; humanitarians urged that the United States aid the suffering Armenians in safeguarding their new freedom against the massacring Turks; radicals demanded that Bolshevist Russia should be given a chance to work out its salvation, while reactionaries clamored for more stringent measures against "reds" of all sorts; jingo elements labored indefatigably for sterner measures against Japan and Mexico; and the "Friends of Irish Freedom" exerted every pressure to induce the United States to recognize the independence of "the Irish Republic."

Serious Problems to Be Faced at Home

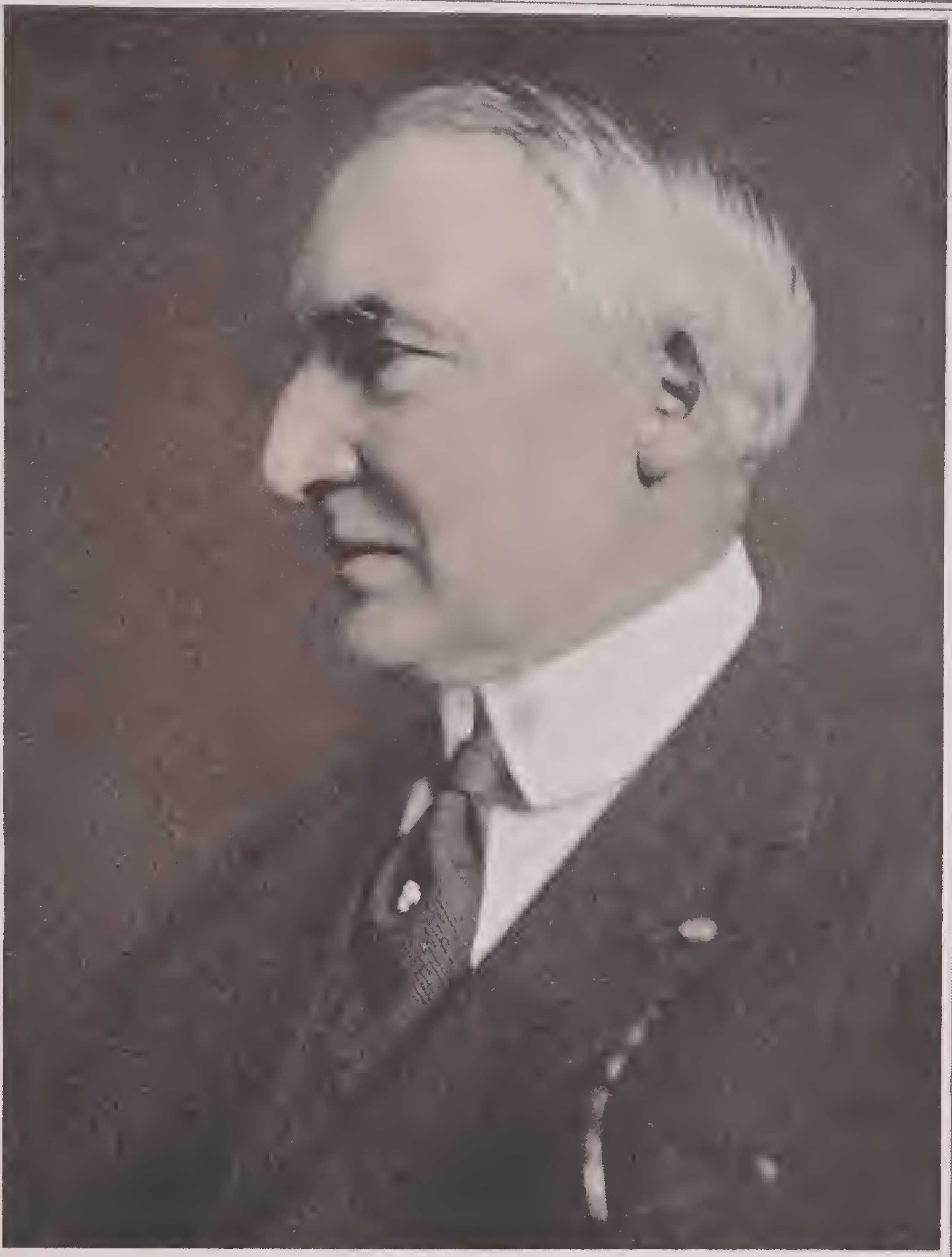
Domestic problems were equally pressing. Heavy taxation and the "high cost of living" were legacies of the war; and business demanded relief from the one while the buying public clamored for a lightening of the burdens of the other. A financial stringency and much unemployment accompanied the economic readjustment. Labor and capital were equally tenacious of advantages gained and resentful of losses incurred. The relinquishment by the Federal government of those powers of control over public necessities—such as food, fuel, and transportation—which it had perforce assumed during the war, carried with it no release from the exceptional problems arising out of these necessities in the transition to peace.

Warren G. Harding of Ohio, who was nominated for the presidency on June 12, 1920, by the Republican convention at Chicago, was a "regular of regulars," and his personality has been compared to that of his Ohio predecessor, President McKinley. He was born in Corsica, Ohio, where his father was a local physician. He was educated at Ohio Central College, Iberia, Ohio; became the publisher of the Marion (Ohio) *Star;* married in 1891 Florence Kling of Marion; was elected to the Ohio senate in 1900, and to the lieutenant - governorship in 1904. He was the unsuccessful Republican candidate for the governorship of Ohio in 1910; and in 1915 was elected to the United States Senate. As a member of the Senate Committee on Foreign Relations, he had favored the ratification of the peace treaty with reservations "sufficient to safeguard the interest of the United States of America."

The Campaign and the League of Nations

The issues on which the campaign was fought were chiefly the respective records of the Democratic president and the Republican Congress, including the attitude of each toward the League of Nations. The Republican platform adopted at Chicago accused the Democratic party of "complete unpreparedness for war and peace," President Wilson of pursuing an "unconstitutional and dictatorial" course, and the Democratic Congressional minority of "partisan obstruction." It declared the administration's foreign policy to be "founded on no principle and directed by no definite conception of the nation's rights and obligations"; and it condemned the covenant of the League of Nations as containing "stipulations intolerable for a free people." The Democratic platform adopted at San Francisco countered by condemning the "failure of the present Congress to respond to the oft-repeated demand of the President and secretaries of the treasury to revise the tax laws," and holding Congress responsible for "failure to restore peace." The platform indorsed the President and expressed approval of the League of Nations as "the surest and only practicable means of maintaining the peace of the world."

The campaign, which, so far as Senator Harding was concerned, was conducted chiefly from his "front porch" at Marion, developed no sensational features. The League of Nations—and in particular Article X of the covenant—constituted the chief point of Republican attack. Senators Borah and Johnson, who favored complete rejection of the League, claimed that Senator Harding was of their view; but advocates of participation in a new or revised league



WARREN G. HARDING

equally claimed his support. The nearest approach to mild flurries of excitement in the campaign occurred when the Democratic candidate, Gov. James M. Cox of Ohio, produced copies of instructions to Republican committeemen urging them to "get the money" (there was no charge that this indicated technical corruption, but merely the dependence of the campaign on large funds); and Senator Harding's employment in his speeches of accusations against the administration of cruelty and misrule in Haiti.

Senator Harding and his opponent were both pronounced "safe and sane" by organs of business and financial interests. Neither was opposed by organized labor.

The election resulted in a "Republican landslide" of almost unprecedented dimensions. Senator Harding received a total of 404 electoral votes, a majority of 277 over Governor Cox, and the Republican majority in both houses of Congress was increased.

Following President Harding's inauguration (March 4, 1921), he turned to the restoration of normal business conditions, with new tariff and tax legislation. A radical reform was the establishment of a budget bureau. Meanwhile the increase of unemployment led, in September 1921, to a conference of economists and labor and industrial leaders, called by the President.

The demands of foreign affairs were no less urgent. By a joint resolution (signed July 2, 1921) Congress declared the war with Germany at an end and treaties of peace were later signed with Germany, Austria, and Hungary. In the Senate these treaties were opposed by the "Irreconcilables" and those Democratic followers of ex-President Wilson who were loath to approve a peace that did not include membership in the League of Nations. Germany was warned by a note from Secretary Hughes that any attempts to avoid the reparations payments would be discountenanced, while another note sent to the Allies made it clear that the United States surrendered none of its rights as a war participant in the disposal of such matters as the German cables and the mandate over the island of Yap, given to Japan against the protest of President Wilson. Moreover, United States diplomatic representatives were instructed to participate in many Allied councils, but to avoid the discussion of strictly European affairs. A call was also issued for an international conference on the reduction of naval armament to be held in November 1921.

HARDING'S ORIGINAL CABINET

Secretary of State,
CHARLES E. HUGHES, of New York.

Secretary of Treasury,
ANDREW W. MELLON, of Pennsylvania.

Secretary of War,
JOHN W. WEEKS, of Massachusetts.

Attorney General,
HARRY M. DAUGHERTY, of Ohio.

Postmaster General,
WILL H. HAYS, of Indiana.

Secretary of Navy,
EDWIN DENBY, of Michigan.

Secretary of Interior,
ALBERT B. FALL, of New Mexico.

Secretary of Agriculture,
HENRY WALLACE, of Iowa.

Secretary of Commerce,
HERBERT C. HOOVER, of California.

Secretary of Labor,
JAMES J. DAVIS, of Pennsylvania.

HARDY, THOMAS (born 1840). Although the books of this great tragic novelist are too gloomy and pessimistic to be "popular," he is one of the few writers whose works have been accepted as classics in their own lifetime. Born near Dorchester in Dorsetshire, England, he has passed most of his long life, as did his ancestors before him, in that region of woodland and heath and moor which he calls by its old name "Wessex" and which forms the setting of most of his writings. He was educated at local schools and by private tutors and for a time studied at King's College in London. At 16 he began the study of architecture and at 22 went to London as assistant to an architect. He had already begun to write and for a time was uncertain whether to make architecture or letters his profession, but after his first really successful novel, 'Far From the Madding Crowd', published in 1874, he decided to retire to Dorsetshire and devote himself to literary work. But doubtless architecture had much to do with the wonderful constructive power shown in his novels. Certainly it is true that "no novelist was ever a better architect."

Hardy is interested in the simple primitive men of the countryside with their strong elemental instincts and passions. Still more is he concerned with nature in all its moods and changes, not only as the great background against which he shows man moving onward to his destiny, but as a power which enters into the very life of man, sometimes sympathetic, more often cruel. In 'The Return of the Native', for example, it is Egdon Heath, in its somber power, that dominates the life of his characters.

What Meredith called his "twilight view of life" gives to most of his work an atmosphere of melancholy and pessimism. Though he is thoroughly modern in the realism with which he depicts common life, even in its ugly and sordid aspects, Hardy is like the old Greek dramatists in his presentation of innocent or helpless men and women as the victims of a relentless fate. It is this that makes his 'Tess of the D'Urbervilles' one of the most terrible as well as the most artistic of all novels.

Hardy's chief novels are: 'Under the Greenwood Tree' (1872); 'Far from the Madding Crowd' (1874); 'The Return of the Native' (1878); 'Tess of the D'Urbervilles' (1891); 'Jude the Obscure' (1895); 'The Well-Beloved' (1897); 'A Changed Man' (1913). His poetry includes 'Wessex Poems' (1898), and an epic drama in three parts, 'The Dynasts' (1903–1908).

"BRER RABBIT" *and His* RELATIVES

Hares and Rabbits. Do you know the difference between a hare and a rabbit? If you do, you know more about these animals than a great many people. In America all members of the family to which hares and rabbits belong—and it is said there are 30 species—are usually called "rabbits," although most of them are hares. Wild rabbits are smaller and have shorter ears and shorter hind legs than the hares. They live and breed in burrows and their young are born blind and nearly naked. Hares do not burrow and their young are covered with fur at birth and have their eyes open. The hind legs of hares are longer than their fore legs; this gives them an awkward appearance but enables them to run faster up hill than down. Rabbits breed five or six times a year; hares two or three times. There are from four to six young in a litter of either variety. Young rabbits breed when they are about six months old, but they do not attain their full growth until they are a year old.

Hares and rabbits are rodents, or gnawing animals, but unlike any other rodents they possess two small incisors, or cutting teeth, behind the large ones in the upper jaw. Scientists believe that these teeth are remnants of two additional incisors possessed by their ancestors, and possibly by other rodents, many years ago (*see* Evolution). Their upper lips are cleft and that is why a deformity of the upper lip in human beings is called "hare-lip." Their tails are short and stand erect. They have five toes on the fore feet and four on the hind feet. They are mostly nocturnal in their habits, that is, they usually remain "at home"—the rabbits in their burrows, and the hares in their "forms," as their nests are called—during the day, and go out to feed at night. They feed upon vegetables, grass, leaves, buds, berries, and the bark of trees and shrubs. They are fond of clover, cabbage, dandelion leaves, and carrots, and sometimes do much damage to gardens.

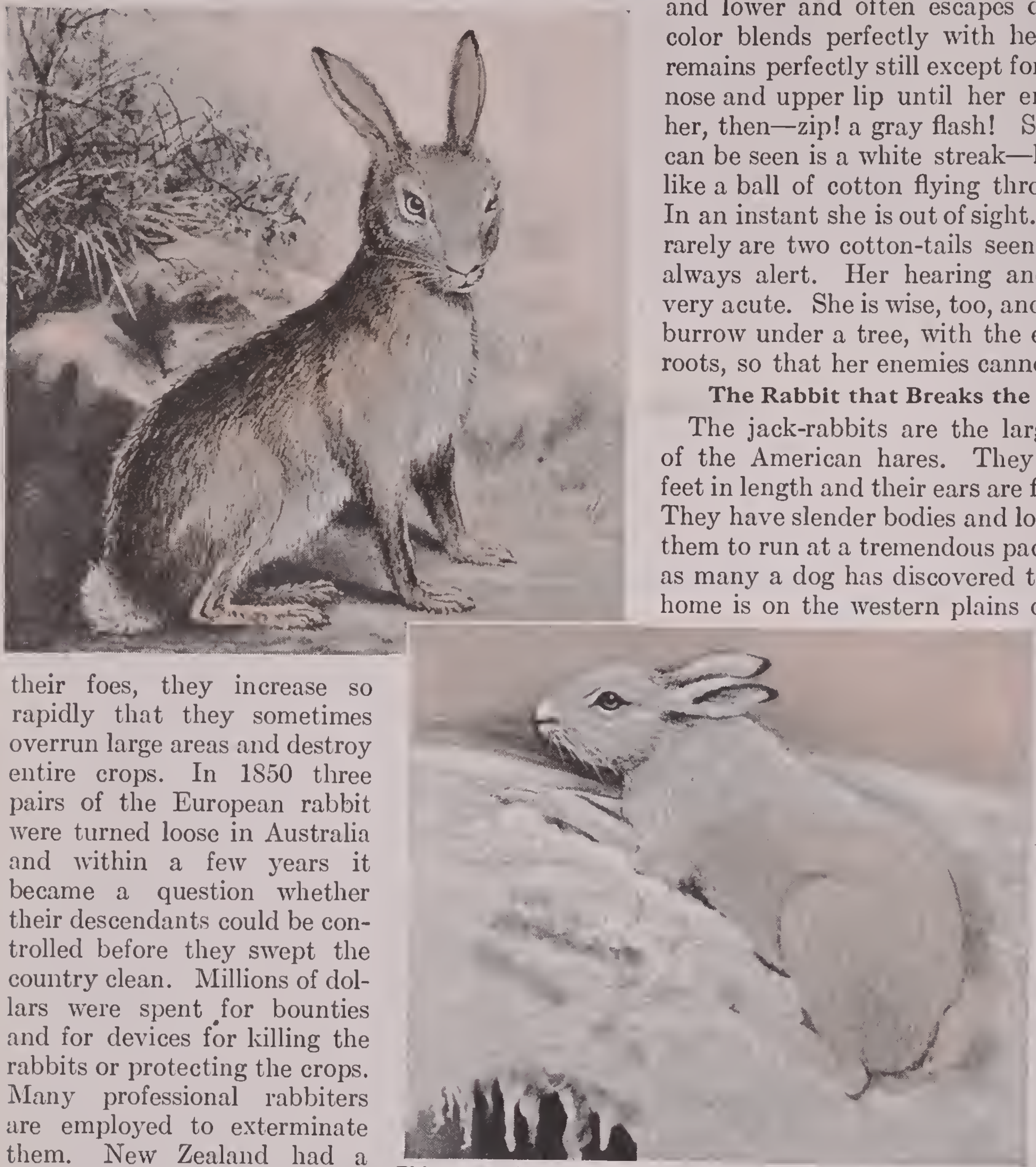
Hares and rabbits are timid but they fight bravely in defense of their young, and in self-defense. They are capable of striking powerful blows with their hind feet and have been seen to knock over a weasel and kill a snake. Domesticated rabbits generally live peacefully with cats, but when differences arise the rabbit usually succeeds in making the fur, as well as the cat, fly. In avoiding their enemies they display much ingenuity and some observers give them credit for being as clever as foxes. When pursued they have a habit of stopping suddenly, almost under the feet of their enemy, and turning with incredible swiftness to run in another direction.

How the Hare Gets His Speed

Their tremendous speed is due to their peculiar method of running, to which the structure of their legs is eminently fitted. When the hare or rabbit takes to flight he leaves the ground with a tremendous leap and for an instant is completely extended. While in the air, however, he brings his hind legs forward until they project beyond and above his head. While bunched in this position, his fore paws strike the ground, one ahead of the other. His momentum tilts him forward, and at the same time he starts swinging his hind legs downward. They strike the ground side by side, but at a spot far ahead of where the front feet are planted. Doubled up thus like a spring, the rabbit "uncoils" suddenly in his next great leap. This method of running is the cause of the peculiar appearance of rabbit tracks familiar to all hunters. They form a pattern like a human face, the marks of the hind paws corresponding to the eyes, and of the fore paws to the nose and mouth. Measurement of these tracks shows that a frightened jack-rabbit covers 15 to 20 feet at a bound.

By man these animals are persistently hunted for their tender and wholesome flesh, and for their fur, which is used to make felt hats. In addition to man, all the beasts and birds of prey are their natural enemies. They are the constant food of wolves, coyotes, lynxes, foxes, mountain lions, and wild cats, and are preyed upon more or less by badgers, skunks, minks, weasels, owls, and hawks. Yet, despite all their foes, they increase so rapidly that they sometimes overrun large areas and destroy entire crops. In 1850 three pairs of the European rabbit were turned loose in Australia and within a few years it became a question whether their descendants could be controlled before they swept the country clean. Millions of dollars were spent for bounties and for devices for killing the rabbits or protecting the crops. Many professional rabbiters are employed to exterminate them. New Zealand had a similar experience a few years later (*see* Australia).

A "TURNCOAT" AMONG HARES



This is the Alpine Hare, in his summer dress above, and in his winter dress below. This long eared fellow is found in Ireland, northern Europe, and as far east as Japan. Many naturalists believe the American Polar Hare belongs to the same species. The change to white in winter helps to make him invisible to his many enemies against the background of snow.

Hares and rabbits belong to a single genus, *Lepus*. The best known and most common American species is the little gray rabbit, or cotton-tail. It is a rabbit, although it does not burrow to the extent indulged in by its European brother, and its young are frequently born in nests, or forms, above ground. The mother cotton-tail generally lines the nest, or covers her naked young ones, with fur from her own body. The total length of the cotton-tail is 17 inches; its general color is cinnamon brown, grayer behind. It is white underneath with a gray stripe across the breast. The under surface of the tail is pure white. The range of the cotton-tail and its allied species is almost the whole of the United States.

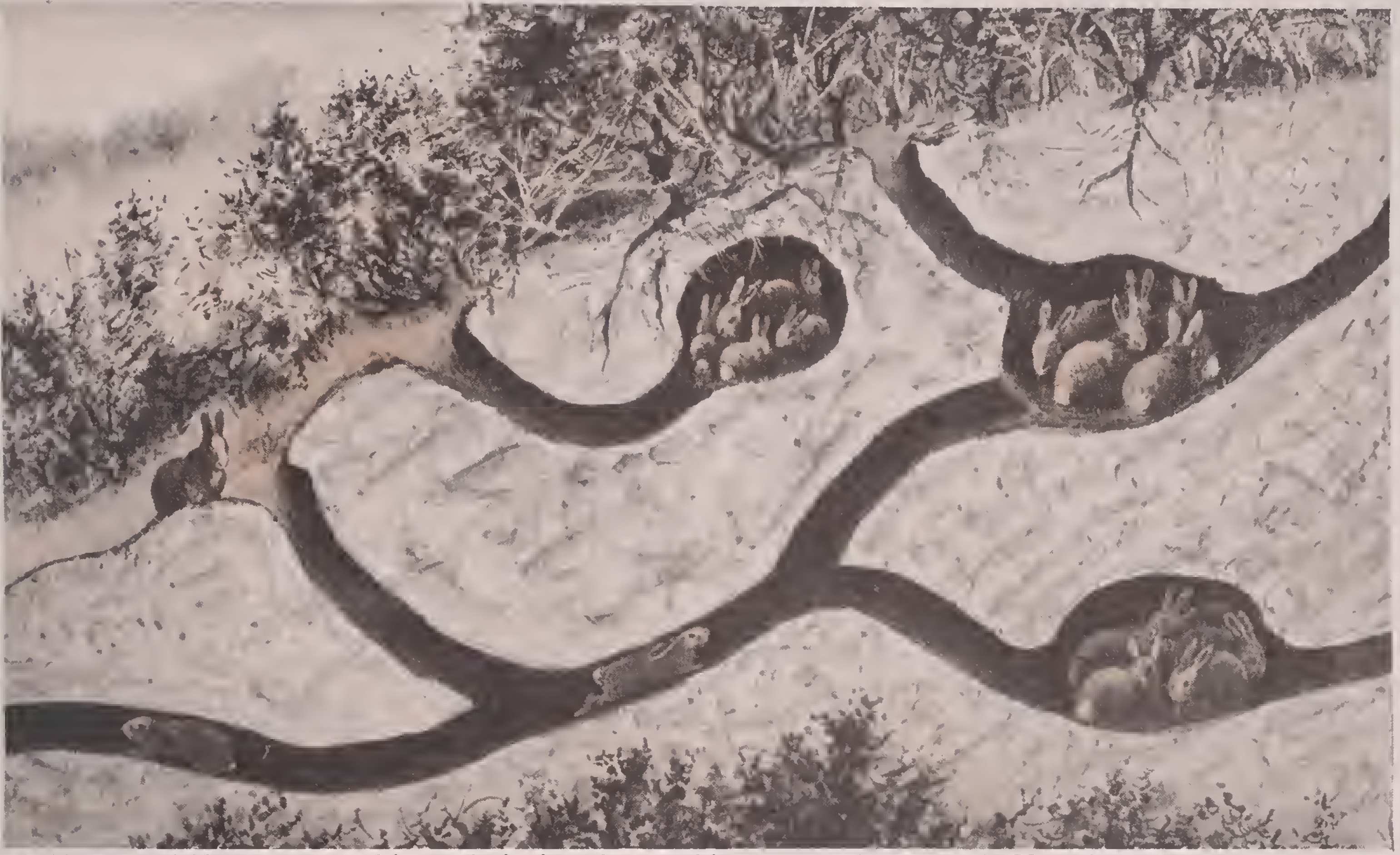
"Molly Cotton-tail" has an interesting habit of crouching in her resting place and remaining motionless when an enemy approaches. She crouches lower and lower and often escapes detection because her color blends perfectly with her surroundings. She remains perfectly still except for the twitching of her nose and upper lip until her enemy is almost upon her, then—zip! a gray flash! She is off and all that can be seen is a white streak—her tail—which looks like a ball of cotton flying through the underbrush. In an instant she is out of sight. Molly lives alone—rarely are two cotton-tails seen together—and she is always alert. Her hearing and sense of smell are very acute. She is wise, too, and prefers to make her burrow under a tree, with the entrance between the roots, so that her enemies cannot dig her out.

The Rabbit that Breaks the Running Record

The jack-rabbits are the largest and best-known of the American hares. They are more than two feet in length and their ears are five or six inches long. They have slender bodies and long legs, which enable them to run at a tremendous pace for short distances, as many a dog has discovered to its distress. Their home is on the western plains of the United States, ranging southward to central Mexico and northward to Saskatchewan. Jack-rabbits increase rapidly and frequently cause much damage to crops. At such times thousands are killed by poisoning and by organized drives in which whole communities participate. The prairie hare is not a jack-rabbit, although it is generally so called. It is smaller than the jack-rabbit, and its color becomes white in winter.

The varying hare, or snow-shoe rabbit, is smaller than the prairie hare but considerably larger than the gray rabbit. Its range is the northern part of the United States and Canada to the Arctic Circle. It sheds its hair twice a year, changing color each time, becoming white in the fall and gray in the spring. It does not get on well with the gray rabbit, and

UNDERGROUND LIFE IN "RABBIT TOWN"



Rabbits are sociable creatures, and form colonies in underground burrows called "warrens." Most of the passages are connected together, with little side "pockets" in which individual families dwell. Mother rabbits, however, usually have separate burrows, as you see in the center of the picture, until the little ones are well grown. The main warren always has two or more entrances, so that if enemies such as weasels and ferrets come in one door, the inhabitants can run out through another. Usually the entrances are made behind the concealing protection of a bush or rock.

leaves the neighborhood when the latter become numerous.

The polar hare is found in the far north, and like other animals of that latitude is snow white, but in the southern part of its range it turns gray in summer. The polar hare has been found within 400 miles of the North Pole. His beautiful fur is highly prized and more than 5,000,000 of these animals and other white-haired varieties are trapped every year.

The swamp hare and the marsh hare are southern varieties that take readily to water and feed on aquatic plants.

In the Old World the common hare is found in all parts of Europe except Ireland, Scandinavia, and northern Russia. It is 20 to 22 inches long and weighs from 6 to 8 pounds. The Alpine hare resembles the varying hare of America. The polar hare is found in Scandinavia and northern Russia; and in Ireland a distinct species (*Lepus hibernicus*) is found.

The European Cony and Other Varieties

The European rabbit or cony differs from the American gray rabbit in many respects. It lives in colonies in burrows called warrens, and in the wild state it is said to mate for life. It feeds at dusk in the morning and evening, and remains in its burrow during the day. This is the species that was introduced into Australia and New Zealand and overran those countries. It is also the ancestor of most of the domestic varieties, many of which have outstripped it in size.

All of the domestic varieties, including the Belgian hares, are rabbits. The Belgian is well known in America, where it is widely bred. It weighs about 10 pounds. The Patagonian is the largest, weighing from 12 to 16 pounds. The lop-eared rabbit is larger than the Belgian and is remarkable for its ears, which lop, or hang down and are from 10 to 12 inches long and 6 inches wide. The Angora is noted for its long, silky fur. Other domestic breeds are the Polish, Flemish, Himalayan, Dutch, Siberian, and silvertip. Snow-white rabbits with pink eyes, called albinos, are favorite pets. They are pretty, easily kept, and become very fond of their keepers.

High in the mountains of northwestern North America lives a queer little rabbit-like rodent called the pika or cony. Other names for it are the tailless hare and the whistling hare. The appearance of the pika is something between that of a guinea-pig and a very small rabbit. Its feet are padded with fur, so that it can leap from rock to rock without losing its footing.

Scientific name of gray rabbit or cotton-tail, *Lepus sylvaticus;* of jack-rabbit, *Lepus callotis;* of prairie hare, *Lepus campestris;* of varying hare, *Lepus americanus;* of polar hare, *Lepus arcticus;* of swamp hare, *Lepus aquaticus;* of marsh hare, *Lepus palustris;* of the Old World common hare, *Lepus vulgaris;* of Alpine hare, *Lepus timidus;* of European rabbit, *Lepus cuniculus.*

TALES THE WOODMAN TOLD

HOW MR. RABBIT LOST HIS TAIL

ONE day, when the Little Boy came to the Woodman's cabin, the ground was all white with new-fallen snow.

"What made those funny marks?" the Little Boy asked. And he pointed to some tracks in the snow that twisted and turned and skipped and hopped, all about the cabin and in the fields and wood beyond.

He had a long tail like a Fox

"Those?" said the Woodman. "Why, those are *rabbit* tracks." Then his eyes twinkled, as they always did when he thought of something funny. "Did I ever tell you how Mr. Rabbit lost his tail, and got his white winter coat so that he can run about in the snow without being seen?

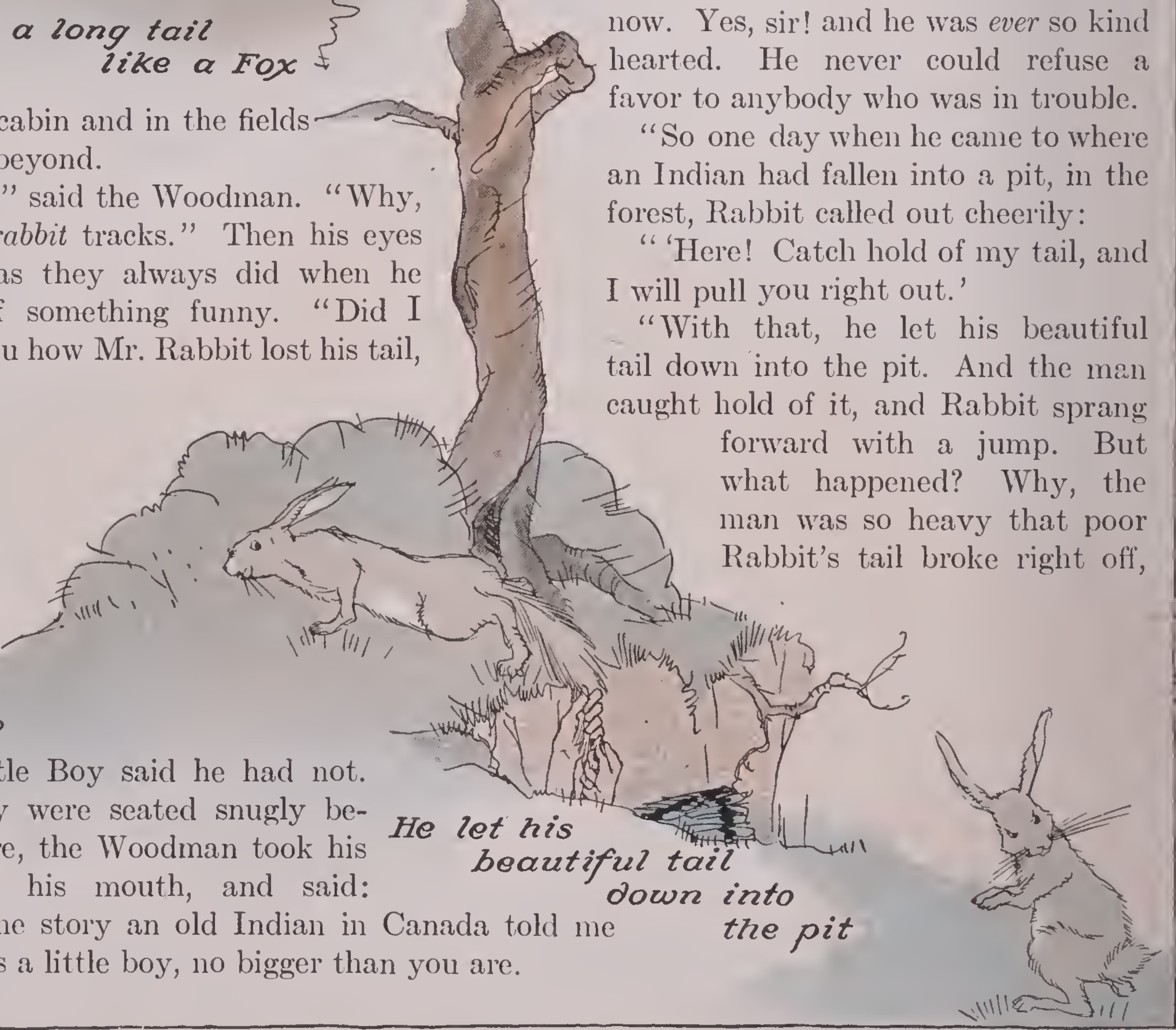
The Little Boy said he had not. When they were seated snugly before the fire, the Woodman took his pipe from his mouth, and said: "This is the story an old Indian in Canada told me when I was a little boy, no bigger than you are.

"A long time ago the Rabbit was a very grand and beautiful animal. He had a long bushy tail like a fox, and he wore a thick brown coat winter and summer. His legs were ever so straight and strong, and he walked and ran just like other animals, and did not hop and skip about as he always does now. Yes, sir! and he was *ever* so kind hearted. He never could refuse a favor to anybody who was in trouble.

"So one day when he came to where an Indian had fallen into a pit, in the forest, Rabbit called out cheerily:

" 'Here! Catch hold of my tail, and I will pull you right out.'

"With that, he let his beautiful tail down into the pit. And the man caught hold of it, and Rabbit sprang forward with a jump. But what happened? Why, the man was so heavy that poor Rabbit's tail broke right off,



He let his beautiful tail down into the pit

Most anybody else would have left him there after that

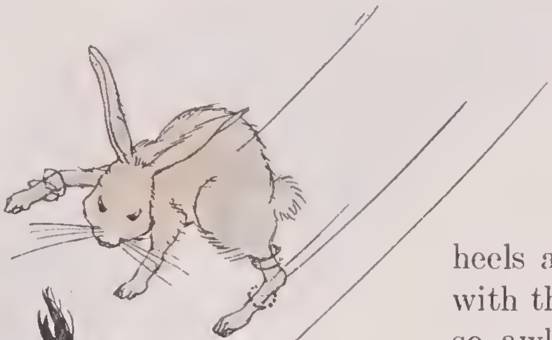
about an inch from its root! And the man fell back again into the pit.

"Most anybody else would have left him there after that! But Rabbit wasn't one to give up an act of kindness when he once set about it. So he seized a tree with his fore paws, and said:

"'Just take hold of my hind legs, and hold on tight.'

"Then the man pulled, and Rabbit pulled, and at last the man was hauled out of the pit.

"But Rabbit's beautiful hind legs were all pulled out of shape! He couldn't walk straight any more, but had to hop along in a funny jumpy sort of fashion.



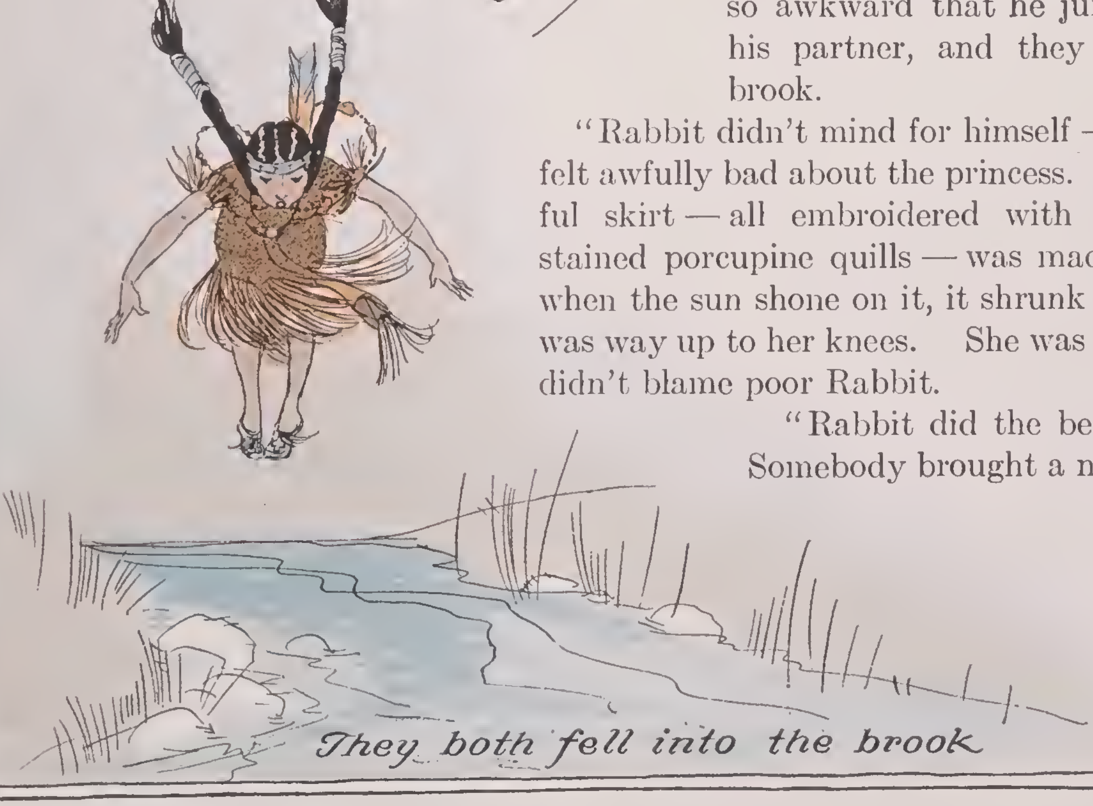
"Of course the man was very grateful to Rabbit. To show his thanks he invited Rabbit to go with him to his wedding; for you see he was on his way to marry a beautiful Indian princess.

"There was great fun at the wedding. Rabbit put rings on his heels and bangles on his neck, and danced with the bride. But his new hind legs were so awkward that he jumped too high with his partner, and they both fell into the brook.

there was great fun at the wedding

"Rabbit didn't mind for himself — not a bit! But he felt awfully bad about the princess. You see, her beautiful skirt — all embroidered with colored beads and stained porcupine quills — was made of buckskin; and when the sun shone on it, it shrunk and shrunk, until it was way up to her knees. She was so ashamed, but she didn't blame poor Rabbit.

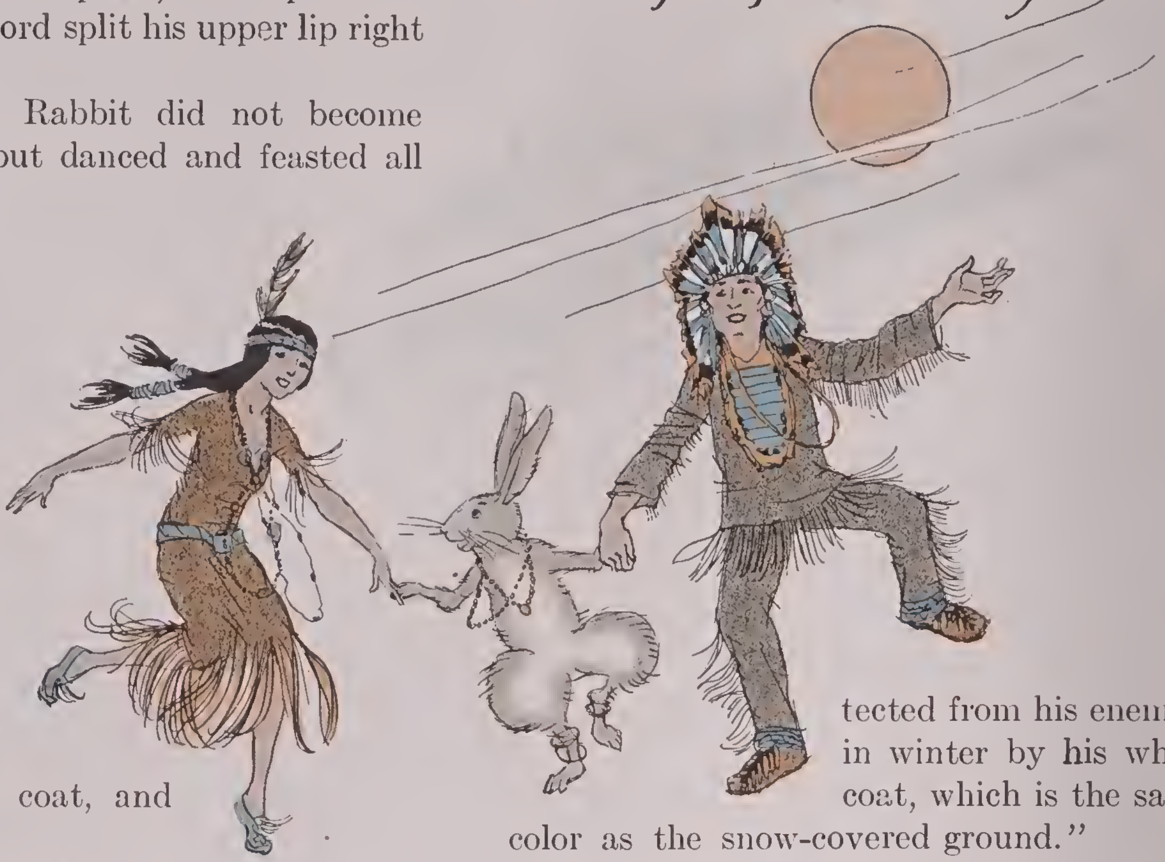
"Rabbit did the best he could for her. Somebody brought a nice tanned deerskin, and he fastened it to the bottom of the bride's skirt. But he was so flustered that this brought him



They both fell into the brook

into new trouble. He held one end of the buckskin cord in his teeth, while tying the other with his front paws; but he pulled so hard that the cord split his upper lip right up to the nose!

"Even then Rabbit did not become downhearted, but danced and feasted all the evening.



They danced until the moon was high up in the sky

"When the party broke up, the man offered to pay Rabbit for all he had done for him. Rabbit did not want to take any payment. But the princess gave him a soft white fur coat, and said:

"'In winter wear this white coat for me. It is the color of snow. But in summer you must wear your old brown coat, which is the color of the dead leaves and grass.'

"So Rabbit took the coat. And ever since — although his lip remains split, and his tail is a mere fluff of cotton, and he goes *hippity-hop* on account of his bad legs — he is protected from his enemies in winter by his white coat, which is the same color as the snow-covered ground."

The Woodman leaned over and picked up a live coal from the fireplace with his fingers, and put it in his pipe, which had gone out.

"Is that story *really truly* so?" asked the Little Boy, with wide eyes.

"Well, perhaps not," said the Woodman. "But anyway that's the story the Indians tell. And you can see for yourself, next time you find a rabbit in the winter."

"In winter wear this white coat for me," she said

HARGREAVES, JAMES (1730–1778). Before the year 1764 little is known about the life of the inventor of the "spinning jenny" beyond the fact that he was a skilled spinner and carpenter who had already made an ingenious "carding" machine for his own use, and that he was living in Stanhill (in Lancashire), where he was probably born about 1730. Then, as now, Lancashire was the center of England's manufacture of cotton goods, but the industry was still primitive, being carried on in the workmen's homes and with hand "cards," spinning wheels, and looms.

Hargreaves' crowded cottage sheltered his family and his workshop. One of the seven children overturned his father's whirling wheel, a lucky accident that gave him the idea for his great invention. Hargreaves had already been experimenting with spinning two threads at once, with the wheel upright and the two spindles held horizontally, but the threads were in too close contact and constantly became tangled. When the wheel was upset the spindles were vertical, and the threads flew apart as wide as the wheel's diameter. Hargreaves seized the idea and set spindles vertically in a frame, so that he was soon able to spin 16 threads at once. This was probably in 1764. He called his machine a "spinning jenny," some say in honor of his wife and others of his daughter.

The amount of cotton yarn he began to turn out alarmed his rivals, who feared his wizard machine would leave nothing for them to do; so they broke into his house and destroyed his spinning jenny. He built another in secret and carried it away to the large town of Nottingham, where he set up a yarn mill. His invention brought him fame but little profit, for when he applied for a patent he was told that he had forfeited his rights by selling several of his machines. Being unprotected by patent the spinning jenny soon came into wide use and the production of yarn was greatly increased.

Other inventors were also at work in solving the same problem, and before Hargreaves' death, in 1778, mechanical spinning was fully developed by Richard Arkwright and Samuel Crompton. The stories of these two inventors, told in separate articles in this work, are sequels to this sketch of James Hargreaves, as is also that of Edmund Cartwright, the inventor of the power loom.

HAROLD, KING OF ENGLAND (1022?–1066). The reign of the ill-starred Harold II, the last king of the Anglo-Saxon period, lasted less than nine months. He was crowned upon the death of Edward the Confessor, in January 1066, and lost his life in October, when the Norman William the Conqueror defeated his troops in the famous battle of Hastings. Ever since that day—except during the days of Cromwell—the English throne has been held by descendants of the Norman conqueror.

For several years before the death of Edward, Harold had been the chief man in the kingdom, and when Edward died without direct heirs, Harold was chosen by the assembly of nobles to succeed to the throne. William, Duke of Normandy, laid claim to the English kingship on the strength of a promise made by Edward that the crown should descend to him, and because of an oath sworn by Harold to aid him. When William invaded England to make good his claim, Harold was in the north, where he had been called to repel an attack by the Danes. Hastening south with his troops, Harold met the Norman invaders, only to fall on the field, surrounded by the corpses of the bravest men of England. (*See* Edward, Kings of England; Hastings, Battle of; William, Kings of England.)

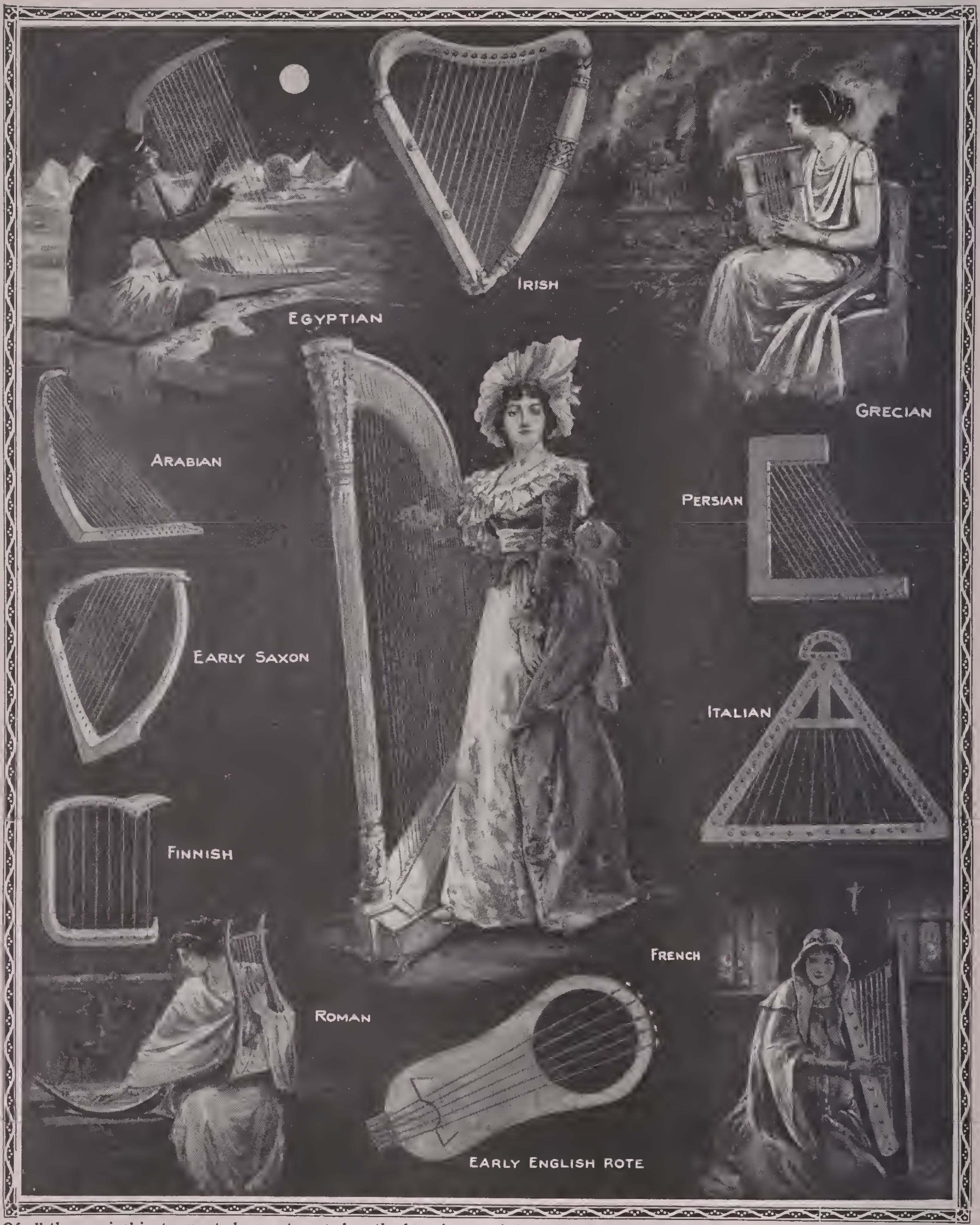
HARP. The harp is the most ancient of stringed instruments. From primitive times men knew that a stretched bowstring gave out a pleasing twanging sound when it was plucked. It is easy to see how some musically inclined genius conceived the idea of adding other strings of different lengths, thus producing an instrument on which simple melodies and chords could be produced. Greek legend tells how the cithara or lyre, a harplike instrument, was invented by the precocious god Hermes (Mercury), who put strings across a tortoise shell a few hours after his birth and made sweet music. The great antiquity of the harp is also indicated by Egyptian paintings, thousands of years old, which picture the harp in various stages of development, from a form obviously derived from the hunter's bow to elaborately carved triangular instruments much like the beautiful harp of modern days. Some of these early Egyptian harps, dating from about 1500 years before Christ, are still to be seen in the British Museum. Much like these were the harps used by the ancient Hebrews in their religious ceremonies and by the ancient Irish people.

In the modern harp the strings are stretched between the sounding board, which rests against the player, and a gracefully curved bracket connecting the top of the sounding board with an upright pillar. Through this pillar pass rods, worked by pedals at the base of the harp, by means of which the pitch of the strings is changed so that the harp can be used in any key.

If a pedal is pressed half-way down, the note is raised a semi-tone; if pressed fully down, it is raised a tone. At one side of the grooves in which the pedals work in the pedestal of the harp are two notches into which they can be hitched when required. So you see that three different tones can be produced on every one of the about 46 strings, giving the harp a very wide range.

These ingenious double-action pedals—of which there are seven—were invented by Sebastian Erard (1752-1831), a French manufacturer of musical instruments, who was also distinguished for his improvements upon the pianoforte. By perfecting the harp in this and other respects, Erard greatly amplified its possibilities for orchestral use, so that now the great scores of Meyerbeer and Gounod, of Berlioz, Liszt, and Wagner are not complete without it.

THE HARP'S ETERNAL CHARM



Of all the musical instruments known to us today, the harp is one of the oldest and most widely popular. In the dawn of history it provided music beneath the Egyptian moon and the sunny skies of Greece, and even in the somber northland of Europe it accompanied the songs of semi-civilized entertainers in Gaelic and Saxon courts. These early harps were far simpler than the modern instrument. The artisans of those days had not learned to build a framework strong enough to support the tension of long heavy strings; and music had not progressed to a point where a wide range of notes was needed for its expression. As time went on however, hand in hand with increased musical skill came increased ability to build harps capable of holding their shape against the pull of great strings, and finally the harp emerged about a century ago in the form we know it—in principle essentially the same as the earliest Egyptian, but capable of yielding an immensely greater variety of musical effects. The present-day harp presents such difficulties and possibilities that a performer can easily spend a lifetime in study and practice without mastering all the difficult points of technique to his satisfaction.

The harp is one of the most difficult of instruments to play and skilful harpists are very rare. But to be able to waken its beautiful tones must well repay long hours of patient study, for its voice is unlike that of any other instrument.

Harpies. In ancient mythology the harpies were conceived as repulsive creatures—birds with the faces of old women, the ears of bears, and crooked talons. One legend relates how Phineus, king of Salmydessus, in Thrace, deprived of his sight by the gods for his ill-treatment of his sons, or for revealing the future to mortals, was condemned to be tormented by two harpies who snatched away whatever food was placed before him and devoured it. In Homer their function is to carry off to the underworld or to some spot beyond human ken those whose sudden disappearance is desired by the gods. The name harpies means "the robbers" and they are supposed to be a personification of the storm winds.

Harrisburg, Pa. In the eyes of strangers, the sumptuous state capitol building, with its fine bronze doors, its sculptures by George Gray Barnard, its mural decorations by Edwin A. Abbey, John W. Alexander, Violet Oakley, and other noted painters, and its decorative tiles and stained glass, is Harrisburg's greatest point of interest. It is one of the finest statehouses in America; on which was spent the huge sum of $13,000,000. But to the citizen of Harrisburg the city's chief pride is not this notable and beautiful building, but the remarkable civic improvements which have given it the name of "Model City."

At the beginning of the 20th century Harrisburg was a prosperous but dirty manufacturing town, supremely ugly and sublimely content. Did not its railroad roundhouses and repair shops, its car works, machine, boiler, and boot-and-shoe factories, its lumber, tin, and rolling mills, its nail works, typewriter factories, and blast furnaces, bring in ever more money? Why worry about trifles like dirty streets, lack of playgrounds, impure drinking water, and typhoid rates?

Then in 1900 the city underwent a change of heart, and in 12 years' time an outward change as well. By a concerted movement of all its citizens, pure filtered water was secured, scores of miles of streets were paved, and a splendid chain of parks and playgrounds was acquired—in short, Harrisburg became a city worthy of its beautiful situation in south-central Pennsylvania on the broad Susquehanna River, with the Blue Ridge Mountains about ten miles away. The city's annual water fête, "Kipona," celebrates the achievement, which is all the more memorable because attained at very slight increase of taxation and without the faintest taint of graft or extravagance. Population, over 75,000.

PRESIDENT *and Grandson of a* PRESIDENT

Descendant of a Family of Patriots—The 23rd Occupant of the White House

BENJAMIN HARRISON

Harrison, Benjamin (1833–1901). Benjamin Harrison, who was President of the United States from 1889 to 1893, was not a politician of the "glad hand" sort. Though he was a brigadier-general of the Civil War, and had long taken an active part in Indiana state politics, he had held only two political offices before becoming president. One of these positions, that of reporter of the Indiana supreme court, was strictly a legal position; and the other office, that of United States senator for six years, 1879 to 1885, had not brought him national fame. Indeed, President Harrison was not a very interesting personality. He was short and stocky, with a neck so short that his head appeared to be set squarely on his shoulders. As he always held his chin back, he was frequently compared by the irreverent to a pouter pigeon. Also his tone and manner were cold. To strangers and even to political friends he appeared almost ungracious. Those who talked with him were met with a frigid look from two expressionless steel-gray eyes; and their remarks were frequently answered in a few short words without the slightest note of interest. In spite of his coldness of manner, however, Harrison could make a good public address. One who knew him well once said: "Harrison can make a speech to 10,000 men, and every man of them will go away his friend. Let him meet the same 10,000 men in private, and every one will go away his enemy."

You may wonder why, with these drawbacks, Harrison was elected president. There were several reasons. In the first place, he possessed a distinguished ancestry. His great-grandfather, Benjamin Harrison, had been a signer of the Declaration of Independence. His grandfather, William Henry Harrison, was a noted Indian fighter and became the ninth president of the United States. His father, though not especially distinguished, had served in the United States Congress for two terms. His own training was such as not to interfere with his availability. His first education was obtained in a log schoolhouse in Ohio, for he was born at North Bend, in the Buckeye State. Then a private tutor prepared him for Miami University (Oxford, Ohio) from which he was graduated in 1852. He was admitted to the bar in 1853, and began the practice of law in Indianapolis, Ind., in the following year.

ADMINISTRATION OF BENJAMIN HARRISON
1889–1893

James G. Blaine, Secretary of State.

"Reed rules" adopted in the House (1890).

McKinley Tariff Act, Sherman Anti-Trust Act, Sherman Silver Purchase and Coinage Act passed (1890).

Pension expenditures greatly increased.

North Dakota, South Dakota, Montana, Washington, Wyoming, and Idaho admitted as states (1889–90).

Territory of Oklahoma opened to settlement (1889).

First Pan-American Conference held in Washington (1889–90).

Bering Sea controversy with Great Britain settled (1893).

Controversies with Italy (Mafia troubles), with Germany (over Samoa), and with Chile.

Reciprocity treaties with Spain and Brazil.

Annexation of Hawaii fails.

People's Party (Populists) organized (1891).

Harrison defeated by Cleveland for reëlection (1892).

A second reason why he was nominated by the Republicans for the presidency was that he had fought in the Civil War. His military exploits did not fire the popular imagination, as did those of his grandfather, but still he had served with distinction in the campaigns in Kentucky and Tennessee, and in Sherman's march on Atlanta; and in 1865 he had been appointed a brigadier-general of volunteers, for "ability and manifest energy and gallantry in command of a brigade."

A third reason—and probably the most important—was that he was one of the most prominent Republican lawyers of Indiana; that he had represented that state in the United States Senate, and that the votes of Indiana were considered necessary to obtain a Republican victory. With Harrison as the candidate for president, the Republicans chose Levi P. Morton of New York for vice-president.

Election Won on the Tariff Issue

The chief issue in the election in 1888 was the tariff. The Democrats who were then in power with President Cleveland were advocates of a lower tariff, while the Republicans stood for a high tariff to protect home manufacturers. John Wanamaker, the foremost merchant of Philadelphia, was campaign treasurer for the Republican party. He appealed to the big manufacturers of the country for money to carry on the campaign, and larger sums were spent in this campaign than ever before, setting a precedent which later caused much trouble to the party.

Harrison won a majority of the electoral votes, although Cleveland, the Democratic candidate, obtained a majority of 100,000 in the popular vote. As the tariff had been the question on which the election was carried, a tariff bill was soon drawn up by Congressman William McKinley, later president of the United States, and was eventually passed. This McKinley Tariff Act provided for higher duties on most manufactured articles brought into the country. That it was not approved by the people was shown by the result of the next presidential contest, in which ex-President Cleveland was reëlected.

The contributions of large corporations to the campaign funds helped to stir up the people against the power of "big business." This hostility was expressed in the Sherman Anti-Trust Act, which forbade corporations to combine so as to control the output of any commodity, and so establish a monopoly. Another law, also drawn up by Senator John Sherman of Ohio, was the Sherman Silver Act, which provided for the purchase by the government of a large quantity of silver each month. This was done to satisfy the people of the West, especially Colorado, who were large producers of silver and opposed the single gold standard in the monetary system.

Clash over Samoa

The chief interest in Harrison's administration, however, centered in foreign affairs. At one time the United States almost came to war with Germany. After Germany had acquired a strong position in Europe by the Franco-Prussian War of 1870–71, it began acquiring colonies and resolved to seize the Samoan Islands, in the Pacific Ocean, regardless of the rights of the natives and of English and American traders. The British author, Robert Louis Stevenson, who was living in Samoa, has left us an account of the haughtiness of the Germans. The United States, England, and Germany all sent war-vessels to the islands, and at one time a terrific hurricane was the only thing which prevented the German and American vessels from fighting. In the negotiations which followed, Germany gave up its claims to exclusive rights in the islands, which were then divided among the three countries.

The Americans thus gained their point with Germany. In a controversy with Great Britain over the killing of fur-seals in Bering Sea, they were not so successful. The breeding place of these seals was the Pribilof Islands, an American possession off the Alaskan coast, and the indiscriminate killing at sea threatened to exterminate these valuable herds. The Secretary of State, James G. Blaine, claimed among other things for the United States and Russia the sole right to fish or kill seals in those waters, on the ground that the Bering Sea was a "closed sea" (*mare clausum*) in international law. But when the matter was submitted to arbitration, the court decided that the United States and Russia could claim the exclusive right only within three miles of their shores, and that anyone could fish or seal outside that limit.

Complications also arose with the Italian government, and with that of Chile. In New Orleans a band of Italian criminals (members of the "Mafia" secret society) were arrested, but a jury failed to convict them. On the night after the trial a mob broke into the jail and lynched the Italians. Italy asked that the leaders of the mob be punished, but the American system of government allowed only the state of Louisiana to do that. As that government gave Italy no satisfaction, she withdrew her representative from the United States. Finally Congress voted to give the families of the murdered men $25,000 each, and the Italian government was satisfied.

The difficulty with Chile likewise arose from the action of a mob, but this time it was a mob of Chileans which attacked some American sailors in Valparaiso. The United States demanded an apology and after a bitter struggle Chile was forced to give it.

Election Lost on the Tariff Issue

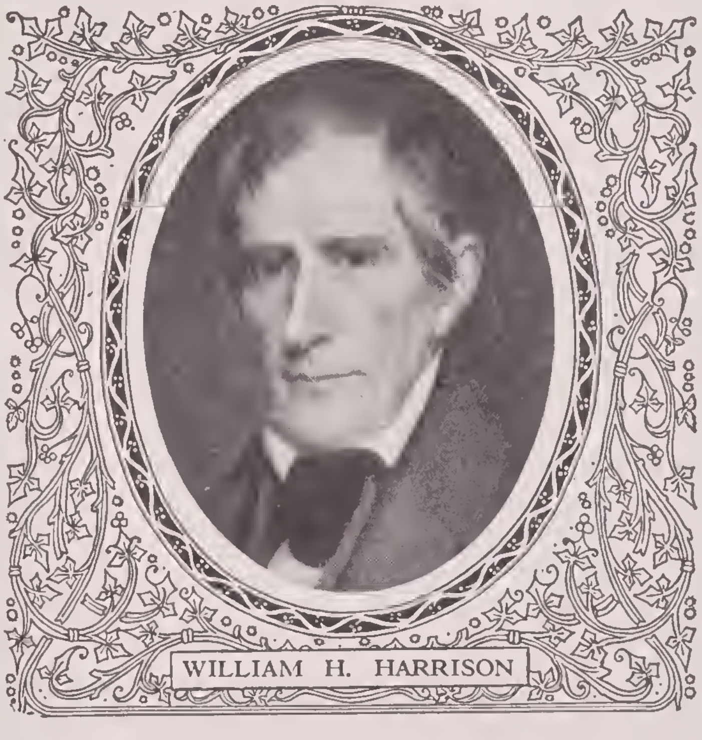
The affairs in Chile and in Samoa are the first indications of America's desertion of her old policy of isolation and her adoption of a world policy. But internal affairs still occupied chief attention, and it was the tariff which gave the election to Cleveland in 1892, after Harrison had served but a single term.

Harrison's fame as a lawyer was much greater than his reputation as a president, and in 1898 he represented Venezuela in the settlement of her boundary dispute with Great Britain. The next year he was one of the representatives of the United States at the Hague Peace Conference. He died March 13, 1901, in Indianapolis after a brief illness.

The INDIAN FIGHTER *Who Became* PRESIDENT

HARRISON, WILLIAM HENRY (1773–1841). If the frontier creates the characteristics which are peculiarly American, as has often been asserted, then William Henry Harrison was a typical American, for most of his public career was spent in the frontier wilderness of the Northwest Territory, or representing that region in Washington. But by birth and education General Harrison belonged to the aristocracy of Virginia. His father was a plantation owner in the tidewater region, who had taken a prominent part in Virginian politics during the Revolutionary War, and had signed the Declaration of Independence. After placing his signature to that immortal document, it is said that he remarked to Benjamin Franklin, "Now we must all hang together." "Certainly," said Franklin, "for you may be sure that if we don't, we shall all hang *separately!*"

As William Henry was the third son of the Harrison family, and the father's property would under the Virginia law of that time go chiefly to the eldest son, a profession was necessary for him. His father sent him to Hampden-Sidney College, Va., 1787 to 1790, and then to Philadelphia to study medicine. But the young man disliked this calling, and at the death of his father, in 1791, he dropped it. President Washington then appointed him an ensign in the army.



The Hero of Tippecanoe, who was the ninth president of the United States and the first president to die in office. His administration lasted exactly one month, from March 4 to April 4, 1841.

Harrison's first active duty was under General Anthony Wayne, in the campaign in the Ohio country against the Indians. He served with distinction in the battle of Fallen Timbers, in 1794, and then was commander of Fort Washington, in Pennsylvania, until 1798.

In 1798 Captain Harrison (as he had then become) resigned his commission in the army, and settled on a tract of land at North Bend, about 16 miles from Cincinnati. That same year President Adams appointed him secretary of the Northwest Territory under Gen. Arthur St. Clair as governor. This was the beginning of an official connection with the Northwest Territory, in which he served as delegate to Congress, as governor of "Indian Territory" after its formation (in 1800) and as superintendent of

Indian affairs. He was the first territorial delegate from any territory in the United States Congress. As such he rendered an important service to the people in obtaining a change in the land policy of the government, so that the public land was no longer sold in vast tracts to the wealthy, but in tracts small enough for the poorer settlers to purchase.

How He Won the Title of "Old Tippecanoe"

As superintendent of Indian affairs he made in all 13 treaties with the Indians, securing the cession of large sections of land in the Northwest. Tecumseh, a chieftain of the Shawnee Indians, and his brother the "Prophet" objected to this giving up of the Indian lands, and claimed that the consent of all the tribes was necessary before the cession could be valid. The chiefs, they said, had "no right to barter away the land for a pewter ring or a keg of liquor." The result was a formidable Indian War, in which Governor Harrison defeated the Indians at Tippecanoe, near Lafayette, Ind. (Nov. 6–7, 1811). This victory made Harrison a national hero, and he was admiringly called "Old Tippecanoe." (*See* Tecumseh.)

In the War of 1812, Harrison with the rank of major-general was in supreme command of the forces in the Northwest. He urged the construction of a fleet on the Great Lakes, and, after the victory of Commodore Perry on Lake Erie, Harrison crossed into Canada. In the Battle of the Thames (Oct. 5, 1813) he defeated the British and put an end to the war in Upper Canada.

Because of difficulties with the secretary of war, General Harrison resigned his commission in 1814. In the following years his admiring fellow-citizens sent him to the United States Congress and to the Ohio State Senate, and in 1828 he was appointed minister to Colombia. But within a year he was recalled from the latter position and retired to his farm near North Bend.

His Nomination for the Presidency

In 1836 General Harrison was nominated by the Whigs for the presidency, and though defeated by Van Buren, he succeeded in carrying seven states. In 1840 Harrison was again the Whig candidate against Van Buren, who was seeking reëlection. The campaign of that year marked a new era in American politics. With it began the monster meetings, the carnival pomp, and the doggerel verse which for years after marked presidential elections. One part of Harrison's residence at North Bend was a log cabin covered with clapboards; and at the opening of the campaign one of his admirers said that his table, instead of being served with expensive wines, was supplied with cider. So "log-cabins and hard cider" immediately appeared at all the Harrison meetings. The cry "Tippecanoe and Tyler too" carried the Whigs to overwhelming victory, making Harrison president and Tyler, vice-president. (*See* Tyler, John.)

But the strain of the campaign, and of dealing with the multitude of office-seekers in the months that followed proved too much for General Harrison's strength. Although in apparent good health at the time of his inauguration, he soon fell ill of pneumonia and died on April 4, 1841—just one month after he took office. He was the ninth to hold the presidential office, and the first to die during his official term.

It is useless to speculate as to what sort of a president he would have made. On the one side are those who hold that "he was not a great man, though he lived in a great time, and he had been a leader in great things." On the other hand, it is pointed out that he was one of the best territorial governors ever appointed in the United States; and that there is no reason for thinking he would not have shown on the national stage the same qualities of broad-mindedness, integrity, tact, courage, and resourcefulness that he had displayed in the lesser drama of the frontier.

HARTE, FRANCIS BRET (1839–1902). When Bret Harte caught the spirit of the lawless primitive life of the early California mining camps and put it into his vivid short stories, he did a new thing. He started the American story of local color and atmosphere, which sprang into instant popularity. He knew the life he wrote about for, though he was born in Albany, N.Y., he had lived in California since he was 15, teaching, mining, and setting type. While he was at work in a San Francisco newspaper office he wrote the first of his sketches and was at once promoted to the editorial staff. He became editor of *The Overland Monthly*, in 1868, and contributed to it 'The Luck of Roaring Camp' and 'The Outcasts of Poker Flats', the most famous of his stories of rough western life. Harte had a talent, too, for humorous verse, and the nation laughed at his 'Heathen Chinee', the Chinaman with the "smile that was childlike and bland," who turned the tables on two white men who tried to cheat him at cards:

> Which is why I remark,
> And my language is plain,

says Truthful James, who tells the story—

> That for ways that are dark
> And for tricks that are vain,
> The Heathen Chinee is peculiar.

Bret Harte's fame had spread so far, meanwhile, that the *Atlantic Monthly* asked him to write for it alone. He went east in 1870, lectured awhile on California life, then was sent as consul to Crefeld in Germany, and later to Glasgow, Scotland. His last years, after 1885, were spent in England, where he died. He was the author of many other short stories and one long novel, but his first stories remained the best. He wrote some serious poems, too, of which certain ones deserve a wider reading than they receive.

Bret Harte's chief works were: Stories: 'The Luck of Roaring Camp' (1868); 'The Outcasts of Poker Flats' (1869); 'The Twins of Table Mountain' (1879); 'In the Carquinez Woods' (1883); 'A Phyllis of the Sierras' (1888). Novel: 'Gabriel Conroy' (1876). Poems: 'The Heathen Chinee' (1870); 'East and West Poems' (1871); 'Echoes of the Foothills' (1874).

HARTFORD, Conn. Second only to Boston and Plymouth among the New England cities in historic importance, Hartford, the capital of Connecticut, has been called "the birthplace of American democracy." The men who founded it, almost 300 years ago, were applying and carrying further the same religious ideas that brought the Puritans to America; in addition they drew up here the first written constitution that ever created a government—the famous "Fundamental Orders of Connecticut," adopted in 1639.

In the center of the city there still remains the old square, though much reduced in size, which was set apart when Hartford was first laid out as a town in 1637. Here, too, is the old State House, dating from 1794, and until lately used as a City Hall, where the famous Hartford Convention met during the War of 1812. Not far away is a marble tablet marking the spot where stood the storied "Charter Oak."

Many transformations have taken place since colonial days, and today Hartford is famous for its manufactures, for its fine public buildings and business houses, for its beautiful parks, and handsome residences. Hartford is one of the greatest insurance centers in the world. Firearms of all kinds, including machine guns, are manufactured extensively, and it leads the world in the manufacture of typewriters. Machinery of all kinds, rubber goods, knit goods, furniture, and carriages are among other important manufactures, and there is a very considerable trade in Connecticut tobacco.

At the head of navigation on the Connecticut River, Hartford is not only favorably located for commerce, but has a beautiful site, commanding splendid views of the Connecticut valley. A magnificent granite bridge, one of the largest and most massive in the world, spans this wide stream, while the narrow Park River, which flows through the center of the city, is crossed by several bridges. There is a magnificent park system, said to be the largest in proportion to the population of any city in the United States. Set against the greenery of Bushnell Park is the State Capitol, beautifully designed of white marble, and surpassed by few buildings of its kind. Among the famous men and women who have lived in Hartford are Noah Webster, Harriet Beecher Stowe, Charles Dudley Warner, and Samuel L. Clemens (Mark Twain). Trinity College and the Hartford Theological Seminary are its best-known educational institutions. Population, about 140,000.

HARZ (*härts*) **MOUNTAINS.** The deep wooded valleys of the beautiful Harz Mountains abound in quaint old German towns, ruined castles, and fantastic rock masses rich with the romance of many centuries. These mountains lie in west central Germany, between the Elbe and Weser rivers, extending 57 miles to the northwest and averaging about 20 miles in width. The upper slopes are bare of trees but grazing is plentiful. The lower slopes support forests of pine and fir. In the Harz, as in Switzerland, the cattle are driven to the upland pastures in the early spring and left until the winter sets in. Around their necks are bells, harmoniously tuned, which tinkle delightfully as the animals graze in the boundless green meadows. In humble little dwellings propped on the hillsides live the country people, who with loving care breed the valuable Harz Mountain canaries and other songsters of the region.

The highest elevation in the chain is the Broken, a mammoth dome-shaped mass of granite, 3,745 feet high,—the highest peak in Central Germany. Long after Christianity had been adopted in other sections of Germany, the Broken remained a stronghold of Teutonic paganism. Even today the peasants are filled with heathenish superstitions regarding the spirits that are supposed to haunt this bald bleak dome, and every year on the first day of May queer ceremonials are held to appease the specter.

The climate on the mountain tops is damp and cold, but in summer the temperature of the valleys is delightfully cool and pleasant, making the region a favorite touring ground. The towns are a never-ending source of enjoyment to lovers of history and romance, especially the little city of Goslar, which lies huddled at the northern end of the range. Here is an ancient castle of emperors, built before the year 1050, the oldest castle in Germany still in a state of preservation. Beautiful roads traverse the whole section, making extended walking trips easy, and the old-fashioned inns along the roadside hold a pleasant invitation to the hungry, thirsty, or footsore traveler.

The richest stores of minerals in all Germany lie in these mountains, making mining the chief industry. Veins of lead with a mixture of silver abound, and gold, copper, iron, and sulphur are also found. From the sulphur great quantities of sulphuric acid are manufactured. Marble, granite, and gypsum are also worked. Some of the inhabitants gain a livelihood in the forests, and the lumber is shipped to all parts of the country. Paper is made in the many small towns scattered along the numerous river valleys.

HASTINGS, Battle of (1066). Duke William of Normandy, who claimed the throne of England against King Harold, succeeded in landing his army without active opposition at the town of Hastings, on the English Channel. At dawn on Oct. 14, 1066, he roused his troops and set out on an eight-mile march to attack the English, who had occupied the crest of a steep curving hill. The English were about as numerous as the Normans, and were packed closely together on foot, protected by their great shields. They repulsed attack after attack of the mounted Normans, hurling darts and lances, and using their long-handled battle-axes with terrible effect. A blow from one of these nearly struck William from his horse, but his helmet, though badly dented, saved him.

Toward evening Harold was struck in the eye by an arrow and fell mortally wounded. His two brothers were already slain, and the picked troops who guarded the dragon standard of Wessex were killed fighting to the last. The rest then fled and victory remained with the Normans. Right among the dead where the English standard had stood and where his own now waved, William had his tent set up and his supper brought to him. In after days Battle Abbey was erected there to mark the spot. This battle was the beginning of the Norman conquest of England which won for William the title of "Conqueror" (*see* William, Kings of England).

Many incidents of the battle, together with the costumes and weapons of the fighters, were pictured by Norman needle-women on a famous piece of embroidery known as the Bayeux Tapestry, some striking scenes from which are shown with the article on English History.

Hastings is still a thriving English town, with a population of about 60,000.

HASTINGS, WARREN (1732–1818). If it was Clive who laid the foundations of the British power in India, it was his successor, Warren Hastings, who built on those foundations in such a way as to produce the Indian Empire of today.

Born in the same year with George Washington, Warren Hastings was early left an orphan under the care of an uncle who sent him to the famous Westminster school in London. He proved a good student, but his hopes of a university education vanished when his uncle died. A clerkship in the East India Company at Calcutta was obtained for him, and there, like Clive, he arrived at the age of 18. When Surajud-Dowlah marched on Calcutta and committed the Black Hole crime (*see* Clive, Robert), Hastings was at a cotton factory near Calcutta and for a time was held prisoner. When Clive marched against the Indian prince, Hastings joined his force as a volunteer and helped to recover Calcutta. Clive recognized his abilities and made him agent of the Company at the court of one of the native princes.

After 14 years in India, Hastings returned to England in 1764. He was now able to indulge that taste for literature which stayed with him all through his Indian career, and met Dr. Johnson and other London literary lights. But Hastings did not lose touch with affairs in India. Through Clive's influence he was appointed to the governing council in Madras, and then, in 1772—following Clive's retirement and the most terrible famine in India's history—Hastings was sent back to India as governor of the province of Bengal. Two years later the districts of Madras and Bombay were brought under his control and he was made governor-general for the Company in India.

Extension of Britain's Indian Empire

His administration, which lasted until 1785, marks a great epoch in the extension of British rule. In the beginning the East India Company was merely a *trading* corporation, having nothing to do with governing the land outside of its few trading posts. Now it took over in addition the chief work of government in wide stretches of the land—collecting the taxes and maintaining armies, and leaving to the native rulers of those provinces only shadowy power. Elsewhere also the Company undertook to furnish the princes with military protection in return for large money payments.

This was a period of great unrest in India. The Mahrattas, a warlike Hindu people of western India, and other races were planning to seize rich sections of the peninsula. Hastings had to watch the interests of the Company and wage wars for the protection of their territories. Meanwhile the French were plotting in the south with powerful Indian princes. Hastings found difficulty in finding money for these various wars, for many of the princes had failed to pay the sums due for their protection. Hastings accordingly forced the Raja of Benares to pay up, and also collected arrears from a weak prince in Oudh who claimed that his mother the Begum (queen) held all his money. These two debts collected, Hastings had money enough for the war in the rich plains near Madras, where Hyder Ali with a huge army was laying waste the land. After defeating two British generals, Hyder Ali was routed by General Coote, and his French allies driven from the sea by a British fleet.

Hastings tried also to reform the Company's service, which had become corrupt after Clive left India. The word "nabob" (*nawab*) originally meant a rich Indian ruler, but so many English traders and soldiers made enormous fortunes and returned to England to spend their ill-gotten money in cheap display, that the word soon was applied to this type of adventurer. Hastings, who spent his own leisure in learning Persian, tried to get the English agents to study the languages and customs of the Indians. He also sought to open trade with Tibet, and to open communication with Europe along the ancient Red Sea route. He left India with the Company's government firmly and justly administered. He retired in 1785, after finishing Clive's great work.

The Unjust Impeachment of Hastings

Hastings' measures in India naturally had created for him a host of enemies, both among the native princes and among the English. Chief of these was Philip Francis, a member of his council, whom he had wounded in a duel at Calcutta. At home the orator Burke and the playwright Sheridan took the lead in demanding Hastings' impeachment by Parliament. For seven years the trial dragged on, and although it ended in his acquittal the great expense made him a poor man. It is chiefly to Lord Macaulay's essay on Hastings that his critics turn when making charges that he had robbed the Begum of Oudh, and other princely rulers of India. Macaulay, who lived in Calcutta for four years as a council member, could have known the facts, but he took little pains to verify the charges, and these have since been proved false.

Hastings died in 1818 at the manor where his ancestors had lived. His last years brought him many public honors, and he died regretted by a host of Indian and English friends and admirers as one of the founders of the British empire in India.

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